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ABSTRACT

Thirteen papers from the University of South Africa's Conference on Distance Education are presented on media and technology. They include: "Making the Abstract Concrete: A Slide/Sound Programme to Illustrate Abstract Concepts on the Concrete Level" (Grace Reeler); "The Microcomputer and Distance Education" (Johanna S. Rossouw); "A Multimedia Approach to Creating Learning Experiences in Distance Education" (Louis J. van Niekerk); "The Training of Teachers by Means of Teletuition: The Audio Cassette and Teaching Practice" (Lawrie McFarlane); "Microteaching and Distance Education--The Self Teaching Experience" (Paul J.N. Steyn); "Written Language as Didactic Medium: From Principle to Technology" (Hannes van Deventer); "Computer-Aided Instruction in Quantitative Management--Part 1" (Ilze Olivier et al.); "Computer-Aided Instruction in Quantitative Management--Part 2" (Erica Ferreira, Gordon Erens); "The Application of Computer Technology in Offering Equal Education Opportunities to Students from First- and Third-World Environments" (J. Dewald Lubbe); "The Law Student and the Law Library" (Jean Burdzik); "The Effect of Advances in Information Technology on the Teaching of Practical Aspects in Computer Science at UNISA" (C.H. Bornman et al.); "Die Gebruik van Inligtingstegnologie in Afstandsonderrig" (N.F. du Plooy et al.); and "Computer-Aided Education as Student Centred Education: Practical Applications for Today and the Future" (P.J. van Dyk). (LB)

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PAPERS 3.2

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Media and technology in distance education

DISTANCE EDUCATION IN SOUTHERN AFRICA: PREPARING FOR THE 21ST CENTURY

18 - 21 MAY 1987

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PREFACE

The conference papers to be presented at the University of South Africa's Conference on Distance Education are contained in a number of volumes for easy reference. The papers have been collected according to basic themes as follows:

The theory and practice of distance education	**Papers 1**
Issues in education and distance education	**Papers 2**
Media and technology in distance education	**Papers 3.1, 3.2**
Professional education and practical training at a distance	**Papers 4.1, 4.2**
Administration and student support in distance education	**Papers 5**
Systems and strategies in distance education	**Papers 6**

This is Volume 3.2 of the papers. The table of contents lists the papers in this volume in order of abstract numbers.

In the alphabetical index all participants' names, the abstract number of their paper, the session allocated and the volume in which the paper is published can be found. Not mentioned are papers that may be published in Volume 7 entitled "Late Submissions".

F. van den Bogaerde
CONFERENCE CHAIRMAN

KEY

ABSTRACTS

1000 SERIES — Participants from Africa and Abroad
2000 SERIES — Participants from southern Africa
3000 SERIES — Participants from the University of South Africa

3100 — Administrative and Professional
3200 — Faculty of Arts
3300 — Faculty of Education
3400 — Faculty of Economic and Management Sciences
3500 — Faculty of Law
3600 — Faculty of Science
3700 — Faculty of Theology

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PAPERS

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MAKING THE ABSTRACT CONCRETE : A SLIDE/SOUND PROGRAMME TO ILLUSTRATE ABSTRACT CONCEPTS ON THE CONCRETE LEVEL

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This presentation will be an attempt to demonstrate how abstract concepts may be made more accessible to students by making use of technology - by creating visual and audible aids, which any lecturer could produce and which could have invaluable application possibilities in a variety of courses.

It cannot be denied that students who enrol for a first year course in tertiary education manifest great disparity in their capacity to cope with the study material with which they will be confronted. From the highly competent, even brilliant student, and from those who barely succeed in qualifying for admission, it will be expected to master the contents of the course. This is true of students who enrol at residential universities as well as those who avail themselves of the opportunity to enhance their education by means of distance tuition. The students who enrol at institutions which provide distance education are, however, even less homogeneous than those at residential universities and specifically in areas such as age, time elapsed since they completed their school career, social background, countries of residence, culture and even their level of abstract thought.

Some freshmen students are able to grasp abstract concepts and reasoning without any difficulty, while others find abstractions a wellnigh insurmountable obstacle. In subjects such as Philosophy, or Fundamental Pedagogics, which is also known as the Philosophy of Education, there are of necessity a number of abstract concepts and it often proves to be a futile exercise to attempt an explanation of one abstract concept by making use of yet another abstract word which also does not fall within the reference framework of the student. There are also many abstract concepts such as for instance, FREEDOM, SECURITY, AUTHORITY, RESPONSIBILITY, and others, which are today subject to highly diverse, and sometimes even diametrically opposite interpretations. If these concepts are to be grasped by students in a uniform manner in their studies of a course dealing with *education* unambiguous definition, on a thought level which is accessible to all, is essential.

Piaget, Brunner (1964), Guilford (Baller & Charles,, 1968) and others have thoroughly investigated human thought and learning processes and have indicated that some people learn more readily when information is presented concretely. There can certainly never be any objection to presenting new concepts in both abstract and concrete form, even when some of the students are capable of assimilating abstract ideas.

Making use of the available technology, the objective was to make abstract concepts more accessible to students by the use of concrete illustrations. To achieve this aim a slide-sound programme, incorporating key concepts which are basic to an understanding of the first year course in Fundamental Pedagogics, was prepared. At Unisa it has become an institution to conduct Group Discussion classes at various venues throughout the country and this slide-sound programme has been used as integral part of these first year discussion classes in Fundamental Pedagogics, for a number of years, with gratifying success. Although large numbers of students attend these classes, distance, time and other considerations do prevent many others from benefitting from this personal contact, this opportunity to ask questions and discuss problem areas. To overcome this problem and present all students with an equal opportunity to make use of the available study material, the programme was also converted to a format which could be mailed to every student, for individual use in his own home, as part of his study material. Instead of mounting the individual slides for projection, they were retained as strips of slides and encased in transparent paper. The sound-track used during discussion classes, incorporates electronic pulses which automatically advance the slides so they are synchronized with the sound. This electronic pulse was replaced by an audible "beep" on the cassettes which were mailed to students, to assist them in coordinating sight and sound. In the times we live in, cost-effectiveness is always of the essence. This programme has certainly remained within bounds and within reach of every student who owns even the most elementary battery driven portable cassette player. Mailing this programme to individual students was tried on an experimental basis during 1985, and the feed-back received from students left no doubt as to its effectiveness.

It may be of interest to note that two other tertiary institutions, Vista University (which is a Black residential University) and the Pretoria Col-

lege of Education, (a white residential teachers training college) also requested copies of this programme for use during their classes. One copy has also found its way to the United Kingdom upon request of a visiting Educationist from that far country.

At Unisa this programme is primarily intended for use during the first series of discussion classes when the objective is to give the students a clear indication of the nature and scope of a first year course in Fundamental Pedagogics, the terminology and a number of key definitions. The content is structured to form a basis or point of departure for the entire discussion class. There are two possible avenues of approach. The programme, which lasts approximately 12 minutes, may be presented in full at the start of the 80 minute class. It is then possible to return to specific slides, without the sound-track, and by means of explanations and questions, students may be led to respond and participate in discussions. By posing a pertinent question about what they can *see* it is often possible to bridge the gap between the concrete and the abstract. What a student has once grasped he can incorporate in his frame of reference, remember and use meaningfully when completing assignments and when sitting for the examination. The other method of approach is starting the programme and stopping at specific slides as the need arises, thus explaining the programme in sections and once again drawing the students into discussion by means of questions, until the programme has been worked through in its entirety. The approach will often be decided by the composition of the class, their state of readiness to commence the class, time of day or some other extraneous influence. It does, however, help to eliminate the irritation of late arrivals if the entire programme is presented at the start, as the opportunity then still exists of returning to any slide which needs further elucidation or in order to stress a point.

The programme has been prepared in both the official languages of South Africa which are also the languages in which courses are presented through the University of South Africa. During 1986 there were 5 300 registered students for the course in Education I, which comprises four perspectives on the education phenomenon, namely, Fundamental Pedagogics, History of Education, Empirical Education and Didactics. Of these 5 300 students the vast majority, 89.1% in fact, studied through the medium of English. The composition of the target group was as follows: Black students, 74.4%, White students, 10.9%, Indian students, 7.7%, students of mixed race 6.7%,

and also two Chinese students - which as a percentage is beyond my mathematical capability! (Bureau for Management of Information, Unisa). The majority of English medium students was comprised of Black students. In the Afrikaans medium group the White students formed the majority. In preparing the English programme, use was made of a Black mother and child and Black pupils and teachers at a school. The Afrikaans programme depicts a White mother and her children and White pupils and teachers. This was done in order to help students to identify more readily with the content of the programme, which are in all respects identical. No professional actors were used either for the pictures or the sound-track, not only for reasons of economy, but also because it was felt that in this way a closer bond could be established between students and the subject content, as well as between students and lecturers.

In order to demonstrate how this programme can help students to internalize facts by drawing them into discussions and leading them towards finding the answers to questions for themselves, I shall briefly refer to some of the slides which help to clarify the concepts "Science of Education - Pedagogics" and "Education as practice - Pedagogy".

When this slide is projected they see two adults in an office situation. They usually have no trouble in identifying these two gentlemen as Pedagogicians. By means of the next slide it is possible to elicit the response that the pedagogicians are engaged in scientific research, that there is dialogue and that they describe their findings. Their activities are, therefore, also of a descriptive nature. When the question is posed: "Does education take place in this situation?" some of the students are suddenly confronted with a problem which does not suggest an immediate answer to them. It is quite interesting to note that the class is often divided on a 50/50 basis with one half saying "Yes" as emphatically as what the other half says "No".

Without supplying the correct answer I now show them the following two slides. By asking: "Who are these people?" and "What are they doing?" they can clearly see the difference and when I once again pose the question: "Does education take place in these situations?" the answer is unhesitatingly: "Yes". It is suddenly clear to them that the essential components of any situation where education takes place are: an adult, a child and pedagogic intervention in the life of the child. By returning to the definition of education these two abstract concepts - the science and the prac-

tice of education have been concretely demonstrated. Information and facts which have been assimilated by seeing and hearing, and also through having been forced to discover the answers for themselves, are grasped more fully and remembered far more readily.

It is possible to depict virtually any concept, even highly abstract concepts, graphically. Perception and discovering association relations, although they encompass far more, are dependent on the efficiency of the senses. Students are more alert and interested when more than one sense is appealed to and when they are involved in the discussion (and even arguments amongst themselves), than when they are forced to sit passively while some lecturer drones on monotonously or, even more unforgiveable, reads from the prescribed study material when students could have derived as much benefit from reading this material for themselves. The aim with any assistance given to students should be to make the unknown more accessible to them. Thus also to show the correlation between the unknown abstract and the concrete situation with which they are familiar.

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THE MICROCOMPUTER AND DISTANCE EDUCATION

Johanna S Rossouw
Department of Fundamental Pedagogics - UNISA

Although I am from a Department that is famous for its philosophical viewpoint I am going to try to be more practical today and discuss the use of the microcomputer by the lecturer in a distance education situation.

Computers can be used effectively for the storage, retrieval and sorting of large quantities of data and are therefore very useful educational tools. Anything that can be done on a typewriter, can also be done with a word processor; anything that is stored in files can be stored in a database and any calculations done by paper, pencil and hand culculator can be done with a spreadsheet. I will only discuss the use of the database and word processor. Lecturers do not have to fear that they might be replaced by computers - computers may replace paper, not people. In America there is a saying "The chips of the Silicon Valley will never be able to replace Mr Chips".

There are three areas in which the computer may be used as a tool: item-banking, individualised commentary on essay type questions and guidance to M- and D-students on how to make use of the computer in their research and writing of their theses.

1. ITEMBANKING

Many Departments make use of multiple-choice questions in their assignments. I am not sure that they always follow the hard work up with an analysis of its results and store items in an item bank. As the technical term for multiple-choice question is "item", this bank is called an item bank (4:263). With each set of cards send to the computer a sheet with an

analysis of the options as well as other statistics are sent back. I will not go into too much detail on the statistics. I am only going to discuss three very important points derived from these statistics in order to store only the items that comply to scientific criteria. These are

* the degree of difficulty (facility value) of the item
* the reliability of the assignment and
* the efficiency of the distractors (options)

1.1 The degree of difficulty

If you have chosen method 1 for the item analysis, the degree of difficulty for each item is given under "moeilikheidswaarde" in appendix A (2:17). In column PJ in appendix B you will find the degree of difficulty for method 2. The degree of difficulty is the proportion of students that answered that item correctly. On the option analysis sheet - appendix C - you will find this proportion with the key option (the correct answer). If you multiply that number with 100 (or shift the decimal comma two places to the right) you calculate the degree of difficulty and the items may be classified as follow (7:32):

Above 70%	easy
60 - 70%	fairly easy
40 - 60%	average
30 - 40%	fairly difficult
Below 30%	difficult

An Item with a degree of difficulty between 40% - 80% is suitable for storage in the item bank (3:140) provided it also complies to the next criteria.

1.2 Reliability

Norm-referenced examination items should be both discriminatory and consis-

tent, two properties that are embodied in the Kuder-Richardson Formula No 20 (KR-20). KR-20 scores of 0.70 and upward are considered indicative of reliability (5:487).

1.3 The efficiency of the distractors

Multiple-choice items rely heavily on the efficiency of the distractors (whether they really distract the students or whether they confuse them). See the Option analysis sheet (appendix C). Options with a degree of acceptibility between 2 - 5% may need more attention, while options with a degree of diffilculty below 2% would have to be substituted with a new option. The last group was too easy or too obvious. It did not distract and therefore was not appropriate to its role.

Items with options with facility values between 5 - 80% are therefore items that would be preferable in an examination paper. They are standardised. These items are the ones you may store in the item bank (database) on your microcomputer.

Various database programmes are available and it is only necessary to specify the filename, records and the fields (1:9). A database which is used in our department will be demonstrated after the lecture.

In contrast to conventional, single answer questions, non-restricted multiple-choice items are capable of including more facts and fewer incorrect responses. A superior multiple-choice format for questions with multifaceted answers consists of a stem followed by a series (e.g. 4) of independent answers. This type of question has 16 (2^4) solutions, ranging from no correct answer to four correct answers. In addition, the non-restricted format is not burdened with the repetitious pattern of one correct answer

coupled with several incorrect responses, a cue that may promote successful guessing. Item analysis can be performed on assignments that include both conventional and non-restricted items. More research is needed in this area.

2. INDIVIDUALIZED COMMENTARY

With the increasing number of students each year at UNISA it becomes more and more difficult to write complete commentaries with each essay type assignment. After the closing date when piles of assignments await marking, it becomes impossible to write the same amount of commentary for these students as was written when there were but a few assignments to be marked. Students thus do not always receive the same treatment.

In our department we have the following arrangements:

While marking the first bunch of an assignment, lecturers make notes of their commentaries. As they proceed marking, they find types of mistakes re-occuring. They then structure these comments under headings:

* 1. Table of content left out
* 2. No introduction or inadequate introductory paragraph.
* 3. Discussion around the topic without coming to the real issue.
* 4. Irrelevant facts and paragraghs
* 5. Conclusion not according to facts in assignment.
* 6. Reference tecnique not satisfactory.
* 7. No Bibliography or incomplete bibliography.

Probably most of the other departments also experience that students tend to neglect the above mentioned points. Lecturers responsible for a course/module discuss these mistakes and together, or separately, write a paragraph on each of them giving students guidance of what is preferable or should have been done, referring (again!) to tutorial letters or prescribed books. This is no memorandum, it is additional help for specific students

with specific problems.

These commentaries are typed onto the the computer with the word processor - each in its own file. With a merge program it is possible to choose which comments you want print out for each student, according to his mistakes. The lecturers also have to compile a letter to the students in which they explain how the system works. In this letter the specific comments for the student are merged, for example only nr 2 and 5 for one student and nr 1, 3, 4 and 6 for the next student. Now lecturers only need to write in the margin "See nr 2 on print-out" and write a 2 on the assignment cover. When all the assignments for one day are marked, lecturers send these assignments to the secretary who makes the print-out for each student, puts it in the assignment cover and sends it back to the lecturer for a signiture on the letter. These letters also contain the student number and name of each student and therefore are truly personalized.

The advantages of this mothod of commentary are:

* Individualized

Each student only receives individualized commentaries on his mistakes and guidance for improving on them.

* Consistent, complete commentaries

Commentaries remain complete with full guidance and do not vary in length or quality when the amount to be marked varies.

* Full guidance is possible

After writing the same commentary a hundred or more times it tends to be shortened to telegram style. With the computer the guidance for each student is typed out in the full so the student can fully understand what was wrong and how he can rectify it.

* Immediacy

Students receive these commentaries with their assignments and not only after the closing date or even much later - when it is too late to assist them. Although much of the mistakes occur frequently and may be discussed in a tutorial letter, students usually prefer to know which of these apply to their essays.

* Not rigid

Each lecturer writes his own commentaries or adds to existing commentaries frequently. He still writes individual comments to those students with mistakes which are not covered in the general commentaries; therefore the lecturer still adds his own personal touch.

* Using modern technology

We have this wonderful new technology - the computer - available and we are obliged to use it to the benefit of our students.

* Positive feedback from students

Some of the feedback received from students are

"... an excellent idea and is most helpful in guiding on to correct mistakes."

"... I found it mostly rewarding as I have gained an in depth insight on how to approach my future studies."

"... the computer key eliminates the problem of students failing to read the lecturer's handwriting."

A short demonstration of this method will be given after the lecture.

3. GUIDANCE TO M- AND D-STUDENTS

Isaac Asimov writes that "... the sum total of human knowledge lacks an index and ... there is no efficient method of retrieval of information" . Then he proposes: "How can we correct this but by calling an a more- than-human memory to serve as an index, and a faster-than-human system of re-

trieval to make use of the system."

Students starting with research on a M- or D-degrees may just as well make use of the microcomputer. Files, records and fields can be used to organise all the sources and relevent material in a data base on the computer. Each source which are used are put in the data file with key words referring to different paragraphs and/or chapters. Afterwards, these records can be alphabetised and paragraphs on the same keywords can be extracted with reference to the source and page. If students initially type their dissertations on the computer with the use of the word processor, editing can be done while the study advisor is reading it. Corrections, additions and deletions can be done immediately after receiving it back. Students may continue with another chapter while his advisor is busy on the previous chapter because another copy can be made for himself. Students may even send a copy of the diskette to the promotor who can make a print-out on his own computer, put his commentary on the same diskette and send it back while keeping the print-out copy.

We have just started using the computer in distance education. There are so many other uses that hasn't been attempted yet and a lot of potential uses that are still uninvestigated. I conclude with Isaac Asimov's words "Man should be ashamed to do things that machines can do better".

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APPENDIX C

Afleierontleding

	1		2		3		GEEN	
AFD 1	PROP	PUNT	PROP	PUNT	PROP	PUNT	PROP	PUNT
1	0.00	0.0	0.18	12.0	0.82	16.3	0.00	0.0
2	0.09	12.0	0.82	17.1	0.09	5.0	0.00	0.0
3	0.73	17.0	0.18	11.5	0.09	12.0	0.00	0.0
...								
15	0.09	12.0	0.18	15.0	0.45	17.6	0.09	5.0

Verduideliking: Die kolomopskrifte dui op die afleiers (alternatiewe). Die rynommers stem ooreen met die vraagnommers.
PROP = Proporsie van studente wat afleier gekies het.
PUNT = Gemiddelde toetspunt van studente wat afleier gekies het.

Bv. 0.45, d.w.s. 45% van alle studente het afleier 3 gekies as antwoord op vraag 15 van afdeling 1 en hierdie studente het 'n gemiddelde punt van 17.6 vir die toets as geheel.

APPENDIX A

Itemontleding - metode 1

'n Ontleding soos hieronder word gedruk:

TOETS 2 MIS100

FREKWENSIEVERSPREIDINGSTABEL

PUNT UIT TOTAAL	1	2	3	4	5	6	7	8	9	10	11	12	13
AANTAL STUDENTE MET DIE PUNT	1	3	10	3	21	28	30	37	10	33	15	11	0

AANTAL STUDENTE	205
NB1 (BOONSTE 25%)	52
NB2 (ONDERSTE 25%)	52
GEMIDDELDE PRESTASIE	7.6
GEMIDDELDE PERSENTASIE	58.1
STANDAARDAFWYKING	2.6

ITEM	MOEILIKHEIDSWAARDE	T-WAARDE	ALTERNATIEWE EN PERSENTASIES							
				NB1	NB2		NB1	NB2		NB1	NB2
* 1	87.80	3.88	1	1.92	21.15	2	0.00	3.85	.. 5	1.92	0.00
* 2	86.83	4.38	1	0.00	0.00	2	0.00	3.85	.. 5	0.00	11.54
* 3	27.32	8.86	1	0.00	1.92	2	32.69	82.69	.. 5**	63.46	1.92
	.....										
	.....										
*13	.....										

TOETSBETROUBAARHEID

RMM	0.4151
RTT	0.5866

SLEUTEL: + GROTER AS KRITIESE WAARDE OP .05-VLAK
* GROTER AS KRITIESE WAARDE OP .01-VLAK
** KORREKTE ALTERNATIEF (ANTWOORD)

APPENDIX B

Voorbeeld van belangrikste dele van itemontleding

TEST SCORE AND CRITERION STATISTICS

		N	MEAN	95% LIMITS	SD	95% LIMITS
0	TEST	11.	18.455	14.946-21.963	5.222	3.649-9.161

DISTRIBUTION OF TEST SCORES

```
.       .....
.       .....
6       1.000  *****
7       2.000  **********
8       2.000  **********
9       3.000  ***************
10      2.000  **********
11      1.000  *****
.       .....
```

MAXIMUM TEST SCORE= 22.
MINIMUM TEST SCORE= 12.
RANGE= 10.

ITEM-TEST CORRELATIONS

NO. OF ITEMS IN THE TEST SCORE=29.

ITEM	NJ	PJ	PW	SJ2	SJ	XBARJ	RXSJ	RX
1	9.	0.818	0.182	0.149	0.386	19.000	0.090	0.232
2	8.	0.727	0.273	0.198	0.445	19.375	0.134	0.302
3	7.	0.636	0.364	0.231	0.481	20.286	0.234	0.486
.	..	.....	.....	.....	.....	.....	.....	.....
.	..	.....	.....	.....	.....	.....	.....	.....
29	0.	0.000	1.000	0.000	0.000	0.0000	0.000	0.000
30	5.	0.455	0.545	0.248	0.498	20.400	0.178	0.357

MEANS AND STANDARD DEVIATIONS OF ITEM STATISTICS

	PJ	RXSJ	RX
MEAN	0.636	0.172	0.404
SD	0.249	0.120	0.277

RELIABILITY COEFFICIENTS

KUDER-RICHARDSON 20	0.828
LOEVINGER	0.261
HORST 21	0.852
MAX. POSSIBLE VARIANCE	80.793

3312

A MULTIMEDIA APPROACH TO CREATING LEARNING EXPERIENCES IN DISTANCE EDUCATION

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University of South Africa

Although a variety of factors affecting the use of media have been identified, the purpose of this paper is to focus attention on the role of media attributes in selecting media for distance education.
A rationale for the use of media in teaching has long since been established by the learning psychologists and it is not necessary to once again put forward a case for the implementation of media. The question which should face teachers in distance education is: Which media are best suited to produce succesful learning results?

In the teaching situation information is transmitted by the teacher to the student in order to attain a set learning objective. Achievement of the objective means that the information has been transformed into knowledge. This is basically the difference between communication and instruction. Instruction and communication can therefore not be regarded as synonymous. However without communication no instruction is possible. In order to convey information as learning content to a student, a lecturer has to code the content in some symbol system, taking into account objectives, didactic principles, methods, techniques and instructional media. All of these aspects are integrated into a teaching strategy to enable the student to achieve the learning objective. The nature of the content, the teaching strategy and most important, the learning objective, play an important role in the selection of the instructional medium.

An educational medium can be any object, person or event that is included in instruction to create a meaningful learning experience for the learner. All instruction requires the use of media to teach learning content representing a particular aspect of reality. All learning is mainly the result of either direct concrete experience or mediated experience of reality. It can be accepted though that most information about reality is obtained by means of mediated experience. Whatever actions a teacher carries out in the classroom, he has to rely on media to convey information to his students.

The question that arises is whether a single medium exists that would enable students to experience learning content as reality. There is a vast difference between reality itself and mediated reality. This is often attributed to the difference between theory and practice. The inability of language often to describe a situation clearly demonstrates this point. In stead of transmitting a clear picture, a student is left with a distorted view of the situation.

The truth is that the "how" (method)and the "what" (content) can never be separated completely and that not only does the teaching strategy, but also the medium employed, bear an influence on the learners perception of reality. McLuhan (in Theall, 1971:28) went as far to state that "the medium is the message". Each and every medium uses a different symbol system to encode information. A learner should also be able to decode the symbol system - an ability which can be referred to as media literacy. A learner who is able to decode and interpret stimuli presented by a specific medium can be regarded as literate regarding that medium. It is thus clear that perception is also influenced by a learner's perceptual frame of reference.

The role of the respective hemispheres of the brain in the processing of information and concept formation should also be noted. It has been found that the left hemisphere dominates

verbal communication, language and numerical ability, logical and analytical thinking as well as motor skills in general. The right hemisphere on the other hand is predominantly responsible for perception of visual images, spacial orientation, total perspectives as well as non-verbal thinking. Sperry states that "...our educational system, as well as science in general, tend to neglect the non-verbal form of intellect. What it comes down to is that modern society discriminates against the right hemisphere". Research on the relationship between the functions of the respective hemispheres of the brain, media attributes and learning should provide interesting results.

The value of instructional media in concept formation is evident. The medium presents not only concrete stimuli to the student but the manner in which the stimuli are organized, as well as the symbolic coding elements intrinsic to the medium determine what concept the learner will form of reality. A lecturer has to bear in mind that different media code learning content differently. A description of an object by means of printed media, or the lecturer himself as a personal medium, or a picture will result in different concepts being formed by the learners.

Traditionally the printed medium in the form of the textbook provided information as learning content. The changing needs of society as well as new insight into the needs of learner have placed new demands on the teacher and especially the teacher in distance education. Whereas in the past the teacher was regarded as a transmitter of knowledgege this function has changed to that of a facilitator of learning. The teacher has to structure an ideal learning environment for his students to experience reality. The selection of media plays an important role in this respect.

A number of reasons obviate the selection of the most effective media to create meaningful learning experiences for students. Some of them are:

* The printed medium and verbal instruction are regarded as the only true means of transmitting content. Perceptual learning as a prerequisite for conceptualization is ignored altogether. According to this point of view all experience can be expressed verbally, in fact knowledge can be obtained by being told about it.

* Many teachers are still sceptical about the role of media. They regard themselves as the sole source of knowledge and fear that they could be replaced by media.
* Until recently clear guidelines for the selection of media did not exist.
* Ignorance about the attributes of media. It is impossible to select the best medium if the teacher is not aware of the possiblities of different media.

Is it better to read the book and then to see the film or vice versa? It can be stated that no film ever produced on a book transmitted the message in the same way. Thompson (1969:12) explains this phenomenon by stating that communication media are not neutral such as transport media. When a parcel is sent from A to B it does not matter whether the means of transport is a bus a train or an aeroplane - the content remains the same.

Every medium possesses certain attributes that distinguish it from another medium. Media-attributes refer to the possibilty of a medium to present for instance objects three-dimensional,in colour or in movement. Many of these attributes are shared by various media. The following table lists the various attributes of media.

Realia. Making use of real life objects such as specimens in Zoology and Botany. Musical instruments, artefacts, technology, field trip, etc.

Symbolic modalities and symbol systems. The most important attributes of a medium are the system of symbols it uses to encode information. It is not always possible to bring reality into the learning situation, the teacher selects a symbol system that would best represent reality. The word "building" is a symbolic representation of a construction, while a drawing of a building would present a different symbol.

Sensory modalities. These attributes relate to the way in which people receive information; they refer to the type of sensory perception: Visual perception, auditory perception, tactile perception, movement, smell, taste, kinaesthesia and multichannel presentations.

Indicators of realism. The name derives from the fact that the medium should reflect reality. For instance, a video tape with sound is a much more accurate reproduction of an event than a series of photographs. The following factors influence the realism of a presentation: Amount of detail, colour, movement, size/dimensions, time and sound. Reality itself is often confusing because of the amount of detail. A more meaningful learning experience is created for instance when a diagram is used to explain the principles of the internal combustion engin, than using a real engin.

Peripheral attributes. These are secondary attributes used as design indicators to draw the learner's attention to specific factors. In visual media the teacher may use arrows, colour, captions, underlining, and so on, and in auditory media sound effects, music and intonation (voice).

Control of information. This refers to the extent of control the teacher or the learner may exercise over the use of media.

The greater the learner's control over the presentation of the content - in other words, the medium - the better the prospects of learning. The following attributes belong to this category:

Referrability depends on such factors as cost, availibility and type of hardware. A book is an example of a medium with high referrability.

Tempo differentiation refers to the control that may be exercised over the tempo of presentation.

Flexibility of sequence and content. In films the sequence of information is fixed while a slide series on the other hand enables the teacher to replace obsolete slides or to select only those relevant to a particular topic.

Interaction with information. Media should allow learners the opportunity to make a response. It is difficult to complete a worksheet during a film, but an audio-slide series gives learners ample oppotunity to respond between the various slides.

By means of this classification Briel (1983:200) wishes to show that media as conveyors of information have attributes that influence the meaning of the information they communicate. He defines media attributes as follows:

A media attribute specifies the type of information that can be presented by the medium as well as the control of and the interaction with the information. Different types of media attributes each have their own influence on the information conveyed by the medium (Briel, 1983:200 - our translation). According to Briel it is advisable to rather select the media attributes best suited to creating a learning experience and then to focus the attention on the media that contain these attributes. This action is preceded by a careful analyses of the kind of learning experience a teacher wants to create for his students.

As no single medium possesses all the attributes required for creating the ideal learning environment, a teacher has to consider a number of media to provide in the learning needs of his students. These media should then be integrated into a teaching stategy as a total. The various symbol systems should complement and relate to each other. An audio casette has little value if it is not accompanied by visual material like diagrams, pictures, photos, etc. It would be very effective if student participation could be elicited by including worksheets or requesting them to consult a few pages in their textbooks.

Effective integration of media in a study package should result in the media "disappearing" and the student involving himself in the learning content. It is the teacher's task to recreate a "reality" that corresponds as closely as possible with reality itself. The teacher in distance education should discard the notion that he is busy preparing study material, what he is in fact doing, is structuring a learning environment.

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CLASSIFICATION OF MEDIA ATTRIBUTES	
1. Realia	Objects Simulated reality
2. Symbolic modalities	and symbol systems Digital symbols Iconic symbols Analogous symbols
3. Sensory modalities	Visual perception Auditory perception Tactile sense Movement Smell Taste Kinaesthesis Multichannel presentations
4. Indicators of realism	Amount of detail Colour Movement Size/dimensions Time Sound
5. Control of information	Ref erability Tempo differentiation Flexibility of sequence and content
6. Interaction with information	
7. Peripheral characteristics	design indicators

(Adapted from Briel, 1983:199)

3317

THE TRAINING OF TEACHERS BY MEANS OF TELETUITION: THE AUDIO CASSETTE AND TEACHING PRACTICE

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1. INTRODUCTION

An art critic once wrote that the world-famous Yehudi Menuhin owed his success largely to his magnificent Stradivarius violin. At his next concert the violinist reacted to this by entertaining the audience to an outstanding performance on an inferior instrument. Halfway through the concert he dramatically broke the violin on-stage and then completed the concert on his Stradivarius.

With reference to this anecdote, Ferguson (1975 : 340) remarked as follows: "Every tool or instrument has its values and its limitations. Even an inferior instrument in the hands of a master may produce something of worth and beauty, while sophisticated apparatus handled by unskilled people may give results not worth writing home about."

While the merits of various media in teaching (such as the tape recorder) may be considered, it should never be taken for granted that the use of these will ensure successful learning by pupils or students. The effectiveness of teaching will always be determined by the extent to which the teacher or lecturer succeeds in conveying his message. "All teaching aids are merely tools. They need the touch of the master." (Ferguson 1975 : 340.)

The ingenuity with which a well-known medium such as the audio cassette can be used for the improvement of the quality of the communication between student and lecturer in the training programme for teachers, will be dealt with in this paper.

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2. MERITS OF THE AUDIO CASSETTE

In his study on the use of sound cassettes in teletuition at tertiary level, Freysen (1985 : 27-33) discusses the following aspects regarding the intrinsic potential of this medium:

2.1 Manageability

It is relatively easy to use the tape recorder. The cassette can be fitted to the recorder within a second, while the built-in microphone simplifies recording procedures considerably. A few simple press-buttons make it possible for even those without any mechanical sense to use this medium.

2.2 Accessibility

The tape recorder is fairly cheap and readily available, should one not possess one personally. It is usually operated by means of torch batteries, and can thus be used anywhere, and at any time.

2.3 Control

When making the recording, mistakes can easily be rectified. The order of certain sections may be changed, or sound effects may be added. The decorder of the information, on the other hand, can listen to the tape as many times as deemed necessary, and can stop the tape at any time for any period of time.

2.4 Standardised format

In contrast to the video, the audio cassette is standardised. It can thus be played back on any recorder, while the light-weight plastic cassette simplifies the packaging considerably. Audio cas= settes can also be duplicated in large numbers very quickly.

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2.5 Permanence

The tape recording can be played and replayed virtually thousands of times without any loss in the quality of the sound. The tape itself can also be used for other recordings.

2.6 Cost effectiveness

The fact that the audio cassette is fairly cheap, and that it can be used to store up to two hours of recording, makes it compare extremely favourably with the production costs to other soft ware such as video programmes. The tape recording is in fact one of the cheapest ways of communicating a message in distance education.

With reference to the above-mentioned intrinsic properties of the audio cassette, it is clear that this medium can play an important part in bridging the gap between lecturer and student in the tele=tuition situation.

3. TEACHING PRACTICE AND TELETUITION

No lecturer involved in the training of student teachers, will deny the importance of a sound academic background in the theory of edu=cation and all its different part disciplines. It is, however, the student's ability to apply all this theoretical knowledge in the prac=tical teaching situation in a school classroom that is the hallmark of a true teacher.

The problem of catering for the practical part of the student teacher's training programme when there is hardly any personal contact between lecturer and student in a distance education institution like the Univer=sity of South Africa, is indeed very difficult to solve. It is this dilemma that made lecturers at the University of South Africa consider the possibilities of the audio cassette in monitoring the teaching per=formance of their students in the real life world of the school class=room.

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4. THE AUDIO CASSETTE IN ACTION

In the first compulsory assignment in the subject didactics course for Physical Science, students are required to plan a lesson for any standard in the secondary school using any part of the appropriate school syllabus for that particular subject. This must be done according to a prescribed outline of the lesson. The lesson must then be taught to a class after arrangements have been made with the local high school. An audio tape-recording must be made of the whole lesson.

The student is requested to listen to the tape afterwards, and must then write commentary on the degree of success of his own presentation. As frame of reference for this self-evaluation exercise, the student is referred to the same mark sheet which will eventually be used by his examiners for the final practice teaching test.

Eventually the initial lesson plan, the tape recording as well as the written commentary on the lesson must be sent to the University for the final perusal of the lecturer concerned. Although it is very time consuming to listen to a 30 minute tape as well as studying the lesson scheme and self-evaluation report before actually being in a position to comment on the teaching performance of the student, this exercise succeeds in eliminating the distance between the student and his tutor. The latter is in an excellent position to judge the proficiency of the student in a real teaching situation. The commentary is directed at the performance of the single student, and this, in fact, is individualised instruction in the true sense of the word. But perhaps the most important advantage of this whole exercise lies in the fact that the student has the opportunity of looking critically at his own teaching performance in front of a lively bunch of school children. No wonder then that most students are much more severe in their criticism of themselves than anyone else would be!

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5. THE OPINION OF HED-STUDENTS

It is obvious that this assignment, and specifically the audio cassette, gives the lecturer the opportunity of actually being present in the classroom where the student is teaching. It is also true, however, that the students themselves benefit to quite an extent from doing this assignment. Particulars regarding their opinion are reflected in the outcome of a questionnaire which was sent to 91 Science subject didactics students at the end of 1986. A total of 28 students (or 30,8%) responded and returned the questionnaire.

In the first question, students were asked how difficult it was to arrange for a class at a secondary school in order to make the recording of the lesson. Their answers are given in TABLE 1 below.

TABLE 1 DEGREE OF DIFFICULTY TO ARRANGE FOR A SECONDARY SCHOOL CLASS

Opinion of students	N	%
It was extremely difficult to arrange for a class	2	7,1
It was fairly difficult to arrange for a class	11	39,3
It was easy to arrange for a class	15	53,6
TOTAL	28	100,0

It is encouraging to note that more than half of the students had no difficulty in obtaining a class for this assignment, while only 7% experienced serious problems in this regard. Of those who wrote comment, three mentioned the fact that they stayed far from the school, and two said that it was difficult to borrow a suitable tape recorder. No less than four mentioned the excellent cooperation with the school and teachers.

In the second question, students had to indicate to what extent pupils co-operated with them during the presentation of the lesson. Their

6/...

answers are given in TABLE 2 below.

TABLE 2 DEGREE OF CO-OPERATION OF PUPILS

Opinion of students	N	%
Pupils co-operated very well and reacted spontaneously	16	57,1
Pupils were hesitant but co-operated reasonably well	11	39,3
Pupils were reluctant to co-operate and acted artificially	1	3,6
TOTAL	28	100,0

It is reassuring that in 96,4% of the responses, pupils gave their co-operation although some of them did not know what to expect in the beginning. In the general comment a total of six students mentioned the fact that pupils were "keen" to answer any questions, while six others indicated that the children wanted the lesson to be a success after they had heard that the recording was part of the University of South Africa's assignment. When asked why he was reluctant to answer any questions, one boy said he was afraid that this answer would be wrong, and that the professor would hear it! One student remarked that she taped quite a few lessons in order to make her class accustomed to the whole situation.

In the third question, students were asked to comment on the value of the assignment. Their answers are given in TABLE 3 below.

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TABLE 3 INDICATION OF THE VALUE OF THE ASSIGNMENT

Opinion of students	N	%
I was forced to look critically at my own presentation	27	96,4
I did not learn much I did not know	0	0
I learnt absolutely nothing, and was bored	1	3,6
TOTAL	28	100,0

With the exception of one, all the students indicated that the assignment forced them to be very critical about their own teaching. In their general comment, five of them mentioned the fact that the experience of listening to themselves on tape, made them aware of all the idiosyncrasies they had. One made the remark that self evaluation is more important than any other form of evaluation, while another student wrote the following: "There is no doubt in my mind that this form of assignment is fully worthwhile."

In the fourth question, students had to comment on the quality of the lecturer's comment. Their answers are given in TABLE 4 below.

TABLE 4 QUALITY OF THE LECTURER'S COMMENT ON THE ASSIGNMENT

Opinion of students	N	%
Comment was comprehensive and informative	16	57,2
Comment was short and interesting	9	32,1
Comment was incomplete and meaningless	3	10,7
TOTAL	28	100,0

It is interesting that nearly 90% of the students were satisfied or fairly satisfied with the comment of the lecturer. Five of them made a special note about the constructive criticism, while four others classified the lecturer's comment as very encouraging. One student

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rated the feedback as the most comprehensive of any assignment in the whole HED-course. Someone else bore witness of the fact that the comment encouraged her to make more lesson recordings for her own benefit!

In the fifth question, students were asked to express their views on the principle of having to make a tape recording of a lesson, and analysing it afterwards. Their answers are given in TABLE 5 below.

TABLE 5 PRINCIPLE OF MAKING A RECORDING AND DOING AN ANALYSIS AFTERWARDS

Opinion of students	N	%
Doing the assignment was of great value	24	85,7
Doing the assignment was of little value	3	10,7
Doing the assignment was of no value	1	3,6
TOTAL	28	100,0

An overwhelming majority of the students (85,7%) were of the opinion that doing the assignment was of great value to them. Of the students who wrote additional comment, six said that they only became aware of some imperfections in their own presentation after listening to the tape, while five of them noted that the self-analyses excercise after the lesson was a very valuable one. Two other interesting remarks were the following: "To hear your own lesson helped me to recognise all those irritating repetitions that I hated in my own teachers", and "I felt my taped lesson was more objectively critted than any of my other lessons"! Finally, one student wrote that the school teacher was of the opinion that more experienced teachers should also sometimes record their own lessons - they would be surprised!

In the sixth question, students were asked to indicate how many attempts they had at making the tape recording before completing the

9/...

assignment. Their answers are given in TABLE 6 below.

TABLE 6 NUMBER OF ATTEMPTS OF RECORDING THE LESSON

Opinion of students	N	%
I taped the lesson once before completing the assignment	18	64,2
I taped the lesson twice before completing the assignment	5	17,9
I taped the lesson more than twice before completing the assignment	5	17,9
TOTAL	28	100,0

Approximately two-thirds of the students taped the lesson once. Six of these students indicated that they only had one opportunity. From this information it may be deduced that students might have preferred to complete the exercise more than once for a variety of reasons, such as the quality of the recording that could have been better, or the fact that no provision was made for possible disturbances while making the recording. Reasons for making two or more recordings were pro= blems with the recorder itself, nervousness on the part of the student, or a lack of spontaneity by pupils due to unfamiliarity with the stu= dent. One student reported that she made three recordings, each with the microphone in a different position. Another student made no less than 20 recordings of various lessons before he was eventually satis= fied enough to submit a tape to the University as part of the assign= ment. Needless to say, this last student must have benefitted tremen= dously from listening critically to each of these recordings of his own lessons. It is doubtful whether any comment of a lecturer could have added anything more to the insight already gained by the student.

In the seventh question, students were asked, in an open ended ques= tion, how they thought the assignment could be improved. Six of those that gave their opinion, gave preference to a closing date for this assignment later in the year. In this regard it might be mentioned

10/...

that one of the objectives of this assignment is to bring students in direct contact with the actual teaching of Science in the school class= room as soon as possible after they have started with the course. In this way the student will most probably realise at an early stage that teaching is not all that simple, and that there is something to be learnt in the subject didactics course!

Other students remarked that it might not be a bad idea to get a cri= tical analysis of the lesson by the school teacher as well. Someone else expressed the opinion that students should be given a second chance after studying the comment of the lecturer.

6. RESUMÉ

Although the tape recorder is not a very sophisticated piece of appa= ratus, it has been proved of invaluable importance for monitoring the practical teaching of students in a teletuition situation. Used for this purpose, the audio cassette is not only of value to the lecturer, but also to the student.

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MICROTEACHING AND DISTANCE EDUCATION - THE SELF TEACHING EXPERIENCE

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INTRODUCTION

The unique characteristics of teaching and learning as included in the teaching act itself, act as guidelines for the contents of the theoretical and practical components of teacher training courses. One of the biggest problems in the structuring of such courses is the gap that exists between theory and practice. By analysing the teaching-learning act it becomes obvious that subject knowledge as such is not the only prerequisite for successful teaching. It is also necessary to acquire a set of instructional skills. Although instructional or teaching skills are founded theoretically, they are aimed directly at teaching practice and should be part of the practical component of teacher training and should be included in the teacher training programme. The training of teachers through distance education has, because of the uniqueness of this form of teaching, its own particular problems with regards to its practical component.

Microteaching as a training technique in teacher training courses was developed during the early sixties to bridge the gap between theory and practice. "Microteaching" describes a training technique where teacher trainees and teachers are subjected to real but scaled down teaching circumstances during which teaching experience is gained. These circumstances are "micro" in the sense that the classes are smaller (5-10 pupils), the lesson time shorter (5-10 minutes) and the subject matter less. Microteaching is furthermore characterised by the fact that the student receives immediate feedback from his lecturer and/or fellow students. To actually define microteaching is quite difficult, which is reflected in the following statement which concerns the development of microteaching in the past two decades:

> The term microteaching was first coined in 1963, but the concept has never been a static one. It continued to grow and change and developed both in focus and in format.
>
> (Allen & Ryan: 1969,vii)

This growth and development that microteaching went through developed into it an inherent flexibility which makes it a tool to be used in different teacher training programmes. It is, however, essential that microteaching never loses its two main characteristics, namely that of simplifying the teaching situation and providing feedback under controlled circumstances. (McAleese: 1973,141)

Microteaching establishes a practical teaching setup in which the normal complexity of the classroom is reduced and the teacher trainee is provided with plenty of feedback on his teaching proficiency. However, a very important characteristic of this reduced teaching situation is the fact that it is always real teaching:

> Microteaching is real teaching reduced in time, number of students,and range of activities
>
> (Shore: 1972,17)

and finds its point of departure in the fact that teaching is a complex act demanding specific skills. These skills can be developed effectively by identifying them and learning them individually. When these skills are mastered successfully they can be used individually or in conjunction with one another in a teaching situation (Trott: 1977,9).

Microteaching is thus primarily aimed at the development of teaching skills which are used in association with classroom behaviour. It is important that these skills are specific, definable, demonstrable and observable. Analysing the teaching act into a set of skills reduces the complexity of the act while simultaneously providing a guideline for expected behaviour (Perrott: 1977(b),2)

TEACHER TRAINING AT THE UNIVERSITY OF SOUTH AFRICA

The training of teachers through distance education at the University of South Africa is of a very comprehensive nature (see Kilpert: 1984). The unique nature and characteristics of distance teaching are combined with the problems of the professional preparation of teachers. This professional preparation of teachers implies a theoretical training of teachers as well as preparing them to use a set of teaching skills unique to their prospective profession. This combination of training components gives teacher training programmes their unique characteristics.

The unique characteristics of the teacher training programme at UNISA stem from the fact that the same theoretical and practical training presented through contact teaching at residential institutions is presented by means of distance teaching at UNISA. The difference between the training at the two types of institutions is not merely situated in the instructional methods and strategies used by the lecturer (see Harley: 1982,171-174), but also in the nature, motivation and needs of the student participating in the programme.

> He is generally an adult student. He has a fairly definite idea as to what he needs and wants, and often an almost equally definite idea as to what he does not want (Lighty: 1971,21).

An analysing a questionnaire completed by H E D (Higher Education Diploma) students (Kilpert: 1984), the particular nature, motivation and needs of the UNISA teacher trainee become evident:

* their average age is thirty one years
* seventy percent are females
* seventy percent are married
* fifty two percent are teaching already
* only five and a half percent are qualified teachers

In comparison to the average teacher trainee at residential institutions the UNISA teacher trainee seems to be of a very different nature. The UNISA student is a motivated, adult student who is qualifying himself with a specific aim in mind.

The teacher training programme at UNISA is, like other programmes at residential institutions, subject to specific directives set by the Committee of Heads of Education. It is important for the student completing his training at UNISA to know that his qualification would be accepted by his potential employers. Whereas the residential institutions directly control the practice teaching under their jurisdiction, the UNISA student has to arrange his own practice teaching period as the students are geographically distributed over the whole country and even overseas. The control of the practical component of the teacher training programme is therefore not in the hands of the lecturer but in the hands of the local authorities (the headmaster and teachers of the school where the practice teaching takes place). The only controlled and meaningful interaction between the lecturer and the student is in the form of a work book which the student has to complete during the teaching practice period.

As the primary task of the lecturer in teacher training seems to be the professional preparation of the teacher trainee for the teaching profession, distance education seems to be at a loss as it will always be dependant on external help for the control of practice teaching. This, however, is where the inherent flexibility of microteaching comes to aid as it can contribute tremendously towards bridging the gap between theory and practice and can provide the student with a means of practicing certain skills under controlled circumstances.

THE UNISA MICROTEACHING MODEL

The concept of microteaching as part of the Didactics component of the HED course was introduced six years ago. Initially microteaching formed part of the group discussions and was therefore part of a contact situation.

During this situation it was expected of the student to present a lesson of between ten and fifteen minutes. This lesson was then evaluated by the lecturer involved as well as by all the students who formed part of the group (usually between five and ten students). The evaluation comprised no more than an assessment of the lesson based on a five point rating scale. No final mark was allotted and the student could therefore not pass or fail the exercise.

This presentation of a microlesson was initially voluntary (an average of 70% of students did however attend these microteaching sessions during the group discussions).

Since the beginning of 1986 the presentation of a microlesson was made compulsory and it formed part of the assignments that the student was supposed to present for examination entrance purposes. The presentation of a microlesson is not evaluated in the sense that a mark is given - the student merely earns a certain number of credits towards examination entrance.

The increase in student numbers necessitated a completely new approach as it became physically almost impossible to accommodate all the microlessons during the group discussion sessions. It was felt, however, that the valuable experience gained by the student during the presentation of a microlesson under controlled circumstances should still be made available. A completely new microteaching model was developed and put into use with the revised H E D course which started at the beginning of 1986 and ran concurrently with the old course being phased out over two years.

The development of a new model for microteaching was necessary as the previous course which ran until 1986 became cumbersome due to a huge increase in student numbers. This resulted in a model for microteaching which meet with the requirements for the UNISA teacher training course:

	F	A. Assessment of trainee needs re teaching
	O	skills
Phase 1	R	Student analysis
	M	
	A	
	T	B. Formulation of aims and objectives
	I	Requirements to be met in microteaching
	V	
	E	
		C. Planning instruction
	A	
	N	
	D	D. Compiling tutorial matter
	S	
Phase 2	U	E. Self teaching by the student
	M	
	M	Modelling
	A	Microclass
	T	Microteaching cycle
	I	Feedback
	V	Self evaluation
	E	
		Feedback to the lecturer
	E	
	V	F. Evaluating student activity
	A	
	L	
	U	G. Evaluating the components of the model
	A	
Phase 3	T	
	I	H. Feedback, revision and improving the
	O	microteaching model
	N	

Some notes on the model as such

Component A

In this component attention is given to the needs of the trainee with regards to the learning and practicing of specific teaching skills. The fact that the UNISA student has teaching experience as such does not eliminate the need that the student might have for improving his own skills or for learning new skills. This component of the model also focuses on an analysis of the student in order to determine his specific needs and characteristics. The heterogeneousness of the students being trained as teachers at UNISA does not constitute a problem, since the primary objective of the course is to qualify teachers.

Component B

In order to have a microteaching model that can be applied effectively in a training course, very clear objectives need to be set. The microteaching in the course aims at changing classroom behaviour of teachers through the acquisition of new skills. Through microteaching the student is given the opportunity to be introduced to some theoretical and practical aspects of selected teaching skills and to learn and practice these skills through self study. This also implies that the requirements that the student must meet be clearly indicated in order to complete the exercise.

Component C

The problems of distance education figure very pertinently in this component as it entails the actual planning of the teaching. One of the most prominent characteristics of microteaching is the very fact that contact between the lecturer and the student is important. In order to bridge this problem, careful attention should be given to the following:

* Selection of subject matter
* Media selection

When selecting the subject matter for the microteaching exercise, the student's ability to comprehend and execute the assignment through reading and listening should be first priority as the use of the audio cassette and the written word forms the nucleus of distance education.

Component D

As self teaching is the basis for executing of the microteaching exercise, the student receives the following study package:

* A sound cassette
* A prescribed book
* A tutorial letter

The prescribed book is mainly theoretical and gives the student sound background information as to the possibilities and limitations of microteaching. It also provides some guidelines for the preparation of a microlesson. The sound cassette contains three microlessons on each side (representing both official languages). These lessons are not "model lessons" but are recordings of lessons presented by students during a previous contact session. The tutorial letter, which is the most important component of the study package, contains the actual assignment to be completed, as well as a set of coding instruments to be used. (see annexure 1)

Component E

The sub-components of this part of the model are included in the actual execution of the assignment set in the tutorial letter that forms part of the study package. The execution of the assignment comprises the coding of the last two lessons on the tape recording (the first one is coded by the lecturer and the coding sheets are completed as an example) and the presentation and coding of an own lesson. It is strongly emphasised that the assignment is not evaluated in the usual sense of the word in that no marks are rewarded. The assignment is credited with 40 credits which are accumulated towards examination entrance together with credits earned for other assignments. The ultimate value of this

microteaching experience lies in the fact that the student is provided with an instrument which he can use to monitor certain aspects of his own teaching abilities under circumstances controlled by himself. The absence of a pass or fail factor removes a certain apprehension and lessens the stress when doing the assignment. It also facilitates an exercise in selfcriticism. Students are encouraged to do the assignment in study groups as the discussion arising from their working together can be very valuable.

Component F

Evaluating student activity during the execution of the assignment merely comprises the crediting of the assignment as it is submitted. The completion of the assignment is in itself a form of evaluation which the student does by himself. The lecturer merely determines if the assignment is done; the student himself has to determine how it is done.

Component G

Evaluating the success of the microteaching exercise in terms of quantifiable results is not possible as it is not designed in such a way. Through the completion of the assignment the student has been introduced to certain teaching skills that need to be developed further according to his own particular teaching style.

Component H

In evaluating the exercise attention is given to problems that arise in the actual presentation of the assignment and a constant improvement of the tutorial matter presented to the student is aimed at. Each of the components of the programme is monitored to ensure that the objectives set for the exercise are optimally reached.

IN CONCLUSION

The use of microteaching in this manner is not a completely new concept

(see Perrott; 1977(a)) as it has previously been used in an inservice training course. It was used, however, to reinforce previously learnt skills and not for the teaching of new skills.

When the nature of microteaching was analysed the conclusion was drawn that it had possibilities for use in the distance teaching configuration as found at UNISA. The incentive behind the modification and adaptation of microteaching for distance education can be found in the following:

> Effective teachers demonstrate a repertoire of teaching skills that enable them to meet the different needs of their students. Teachers can be trained to develop these skills, but the process requires considerable effort (Ryan & Cooper: 1980,190)

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UNIVERSITY OF SOUTH AFRICA

DEPARTMENT OF DIDACTICS

HED (POST-GRADUATE)
HED (TECHNICAL)

TUTORIAL LETTER 104 FOR DIDHOD-8
TUTORIAL LETTER 104 FOR DIDHOT-Q
TUTORIAL LETTER 105 FOR DCEOOO-U
TUTORIAL LETTER 105 FOR DCETOO-6

ASSIGNMENT 05 FOR DID40D-8 AND DIDHOT-Q
ASSIGNMENT 09 FOR DCEOOO-U AND DCETOO-6

Dear Student

In tutorial letter 101/86 a microteaching assignment to be executed and completed by the student himself, was mentioned. This tutorial letter includes the necessary subject matter and other material to enable you to complete the assignment.

The objective of the microteaching assignment is to provide the opportunity to look at your own lesson presentation from an analytical point of view under controlled circumstances (although you control it yourself.) It is therefore imperative to read the first *six* chapters of your prescribed book. *Teaching and Microteaching* carefully. It will give you a good idea of the establishment and growth of microteaching as a training technique as well as its possibilities and limitations in the teaching situation. Because of the uniqueness of the teacher training set up at UNISA, it is, however, necessary to adapt the microteaching technique somewhat. The adaptation of microteaching does not influence its relative effectiveness as a training technique.

1. THE ASSIGNMENT ITSELF

This particular assignment comprises three main components

1.1 Listen, observe and learn.
1.2 Listen, observe, and code.
1.3 Lesson presentation, listen, observe and code.

2. TUTORIAL MATTER

To be able to execute the assignment you need the following:

2.1 A casset recording.
2.2 Observation instruments (assessment scales).
2.3 A class (Fellow students or pupils).
2.4 The prescribed book *(Teaching and Microteaching.)*

3. WHAT SHOULD YOU DO?

3.1 Read *Teaching and Microteaching* attentively.

3.2 Listen to the first lesson on the tape recording (three lessons are recorded in English on one side with three Afrikaans lessons on the other side of the tape) and study the included, completed observation instruments. You will have to listen to the lesson more than once. Observe the different aspects of the lesson as represented by the different observation instruments.

3.3 Listen to the second lesson and complete the observation instruments included in this tutorial letter – it should be obvious that you'll have to listen to the lesson more than once again.

3.4 Repeat the procedure in 3.3 with the third lesson on the tape. (If you feel like it you may make photocopies of the observation instruments and repeat the procedure with the Afrikaans lessons on the reverse side of the tape.)

3.5 Now plan your own microlesson in any school subject. (Please consult chapter 7 in *Teaching and Microteaching*. Plan a *complete lesson* which would take no longer than 10 minutes to present. (See also Curzon chapter 15.)

3.6 Arrange for a class. Your class can be made up of between five and eight pupils. If you are part of a study group, your class can consist of fellow students – it may lead to very interesting discussion!

3.7 Present your prepared microlesson to the class. Record your lesson on tape as you will have to listen to it more than once. You'll also have to return the tape recording to UNISA as part of this assignment.

3.8 Listen to the tape recording of your lesson and transcribe it. (Write down evrything that has been said in the lesson.)

3.9 Listen to the tape recording again and complete the set of observation instruments included for your own lesson.

3.10 Send in the completed observation instruments for the last two lessons on the tape and your own lesson as well as the tape recording and the transcription of your own lesson to UNISA as an assignment. Please indicate the relevant assignment number clearly. Please include the tear-off form in the back of this tutorial letter in the assignment.

4. OBSERVATION/CODING INSTRUMENTS

In order to obtain the necessary background for the evaluation or coding of microlessons you have to study chapter eight of *Teaching and Micro-teaching* carefully. You can also look at chapter six of the study guide for guidance.

In the observation of a lesson (when doing this assignment), three aspects thereof will be taken into account. Each of these three aspects necessitates the use of a different observation instrument. The three aspects are the following.

* The observation of *basic interaction* between teacher and pupil in the lesson.
* The observation of the application of the *skill of questioning* during the presentation of the lesson.
* The observation of *reaction* by the teacher i.e. the ability of the teacher to react to pupil contribution during the lesson in order to reinforce the act of learning.

4.1 *INTERACTION IN THE LESSON*

The instrument to be used here is BIAS (Brown's Interacion Analysis System) (Brown 1975, p.66-85). An example of this instrument should look like this:

BIAS (Brown's Interaction Analysis System)

5 - Second Intervals																											
TL	/		/	/		/		/				/	/		/			/									/
TQ									/										/						/		
TR											/					/		/		/				/		/	
PR		/			/					/				/				/									/	
PV															/									/				
S								/																				
X	/																											

(2½ minutes)

TL – Teacher describes, explains, narrates, directs.
TQ – Teacher questions.
TR – Teacher responds to pupils response.
PR – Pupil's response to teachers questions.
PV – Pupil volunteers information, comments or questions.
S – Silence.
X – Unclassifiable.

(This observation instrument is spesifically dsigned to monitor *verbal interaction.*)

This instrument is utilised by identifying a specific interaction every five seconds while listening to the lesson. A mark is made in the corresponding square on the instrument. The end result, should give a good indication of the interaction in the lesson. Was there too much teacher talk? How many times were the pupils involved? etc.

This instrument could also be utilised to describe the activities that should be present in the presentation of a lesson. It is therefore typical of a teaching model.

4.2 *QUESTIONING*

Please consult chapter six of your study guide and chapter eight of *Teaching and Microteaching*. (For a very clear exposition of the levels of learning as set out by Bloom see Curzon chapter eight.)

The instrument used here to observe questioning is one developed and used by Surling University in the U.K. (Stoddart 1978 p. 28).

Questioning	Question number														
	1	2	5	4	5	6	7	8	9	10	11	12	13	14	15
Higher Order									/	/			/	F	
Middle Order		/	/				/	F							/
Lower Order	/			/	/	/					/	/			

Every time a question is set during the course of the lesson, a mark is made in the square opposite the particular type of question. A F in the square following a mark indicating a particular question indicates a follow-up question (see study guide). A question should therefore be judged in the lesson context. "Why did the winners strike?" could, depending on the context in which it is put, be either a higher, middle or lower order question.

The use of this instrument does not imply a time factor. The questions are merely indicated in the sequence in which they are put. The end result gives an indication of the type and frequency of the questions put during the course of the lesson.

4.3 *REACTION (STUDY GUIDE CHAPTER 6; TEACHING AND MICROTEACHING CHAPTER 8)*

This skill gives an indication of the ability of the teacher to react to pupils' contribution in order to facillitate reinforcement, give feedback and establish a pleasant atmosphere in the classroom.

As this is also a skill identified and described by Stirling University, the instrument developed by them should aptly be used.

REACTING

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Praises		/									/				
Accepts	/			/	/		/					/		/	
Relates		/						/	/				/		
Uses			/							/				/	
Other															

Every time the teacher reacts it is coded accordingly and in sequence. It is important however, to note that "accepts, relates and uses" are put in hierarchical order and that they may overlap in meaning. If "relates" includes "accepts" it should be coded as "relates". The same is true for "uses" - if it implies both the preceding two, it should be coded as "uses".

5. OBSERVATION INSTRUMENTS CODED FOR THE FIRST LESSON ON THE TAPE RECORDING

5.1 *INTERACTION ANALYSIS*

BIAS (Brown's Interaction Analysis System)

	5 - Second Intervals																										
TL			/	/			/	/	/	/	/				/	/	/	/	/	/			/		/	/	/	/	/
TQ	/				/							/	/								/		/		/				
TR																													
PR		/				/								/								/							
PV																													
S																													
X																													

(2½ minutes)

	5 - Second Intervals
TL	/ / /

	5 - Second Intervals
TL	
TQ	/ / /
TR	/ / /
PR	/ / / /
PV	/ /
S	
X	

(2½ minutes)

(The duration of the lesson was approximately 8½ minutes).

5.2 *QUESTIONING*

Questioning	Question number																	
	1	2	5	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Higher Order													/					
Middle order			/	/		/	/	/	/	/		/				/		/
Lower order	/	/			/						/			/	/		/	

5.3 *REACTING*

REACTING

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Praises	/						/	/		/	/	/	/		
Accepts		/	/	/		/			/				/		
Relates					/					/					
Uses															
Other															

6. CONCLUSIVE REMARKS

The rest of this tutorial letter comprises a form to be completed and observation instruments to be completed for the additional two lessons on the tape as well as your own lesson. The date of submission for this assignment is 8 August 1986 and NO EXTENSION OF TIME WILL BE GIVEN. This assignment should be regarded as an exercise and is not aimed at evaluating your teaching skill. When you complete the assignment you will neither fail nor pass. It will, however, earn you *40 credits* for examination entrance. Incomplete or shoddy assignments will not earn the necessary credits and will be returned.

N.B. Video tapes of the lessons recorded on the audio tape sent to you are available at the library (main library and regional libraries). You are welcome to use them in completing your assignment. They are available in limited quantities however.

Good luck with the assignment. Give it your best!

Best wishes

Your lecturer

Prof. P.J.N. Steyn

Tel. 440-2469 (W)
62-8818 (H)

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PS. The form containing your particulars, the tape with your microlesson, the transcription of your lesson and the completed observation instruments should be put in an assignment cover and sent to ASSIGNMENTS. Don't forget the assignment number! Put the cassette in an envelope and staple to the inside of the assignment cover.

Student should only complete square with name & adress.

Name:

Adress

Code

Student no.

The following is a checklist - it will be completed by the lecturer upon receiving the assignment.

Assignment 05 - Microteaching.

Completeness:
1. Sound tape
2. Transcription
3. Coding lists for lessons 2 & 3
4. Coding list over lesson

Neatness:
Excellent
Acceptable
Shoddy

Credits:

Remarks: .....

.....

Lecturer: .....

1. TO BE COMPLETED BY STUDENT

Coding scales for lesson 2 (on tape).

1.1 *INTERACTION ANALYSIS*

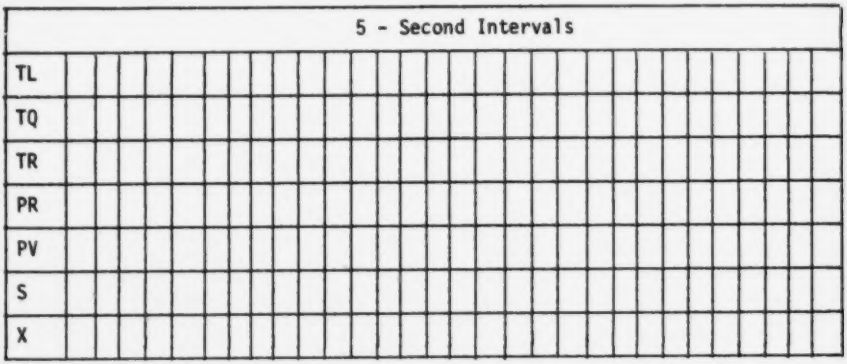
BIAS (Brown's Interaction Analysis System)

	5 - Second Intervals
TL	
TQ	
TR	
PR	
PV	
S	
X	

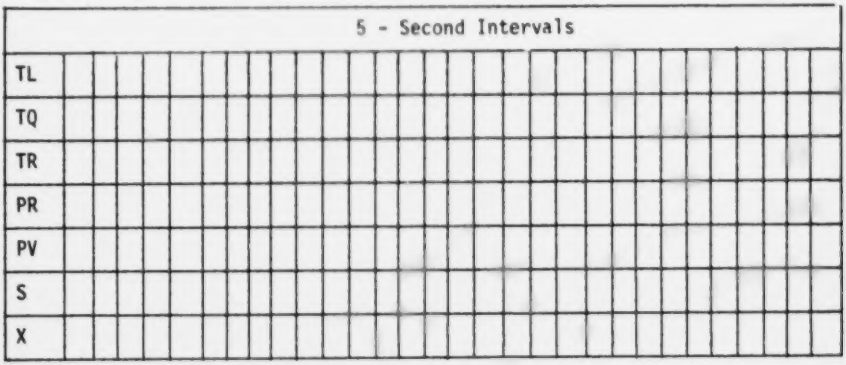
(2½ minutes)

	5 - Second Intervals
TL	
TQ	
TR	
PR	
PV	
S	
X	

(2½ minutes)



(2½ minutes)



(2½ minutes)

1.2 *QUESTIONING*

Questioning	Question number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Higher Order															
Middle Order															
Lower Order															

1.3 *REACTING*

REACTING

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Praises															
Accepts															
Relates															
Uses															
Other															

2. TO BE COMPLETED BY STUDENT

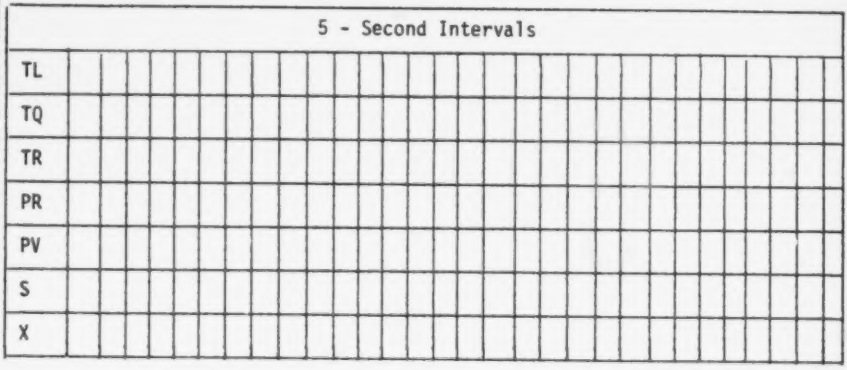
Coding scales Lesson 3 (on tape)

3.1 *INTERACTION ANALYSIS*

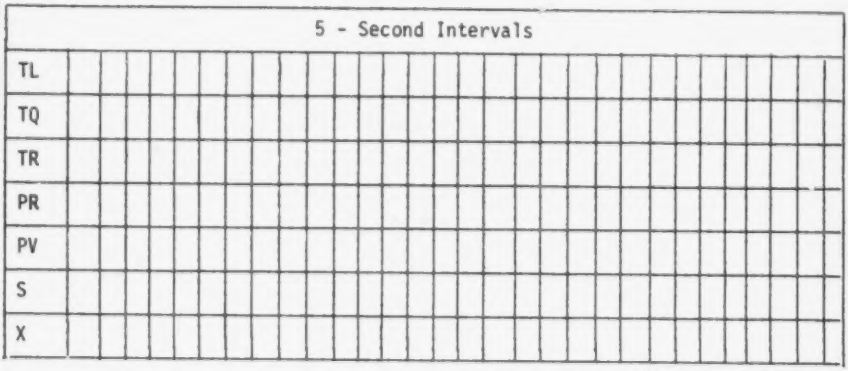
BIAS (Brown's Interaction Analysis System)

	5 - Second Intervals
TL	
TQ	
TR	
PR	
PV	
S	
X	

(2½ minutes)



(2½ minutes)



(2½ minutes)

	5 - Second Intervals
TL	
TQ	
TR	
PR	
PV	
S	
X	

(2½ minutes)

2.2 *QUESTIONING*

Questioning	Question number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Higher Order															
Middle Order															
Lower Order															

2.3 *REACTING*

REACTING

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Praises															
Accepts															
Relates															
Uses															
Other															

3. PRESENT YOUR OWN LESSON AND RECORD IT.

4. PREPARE A TRANSCRIPTION OF YOUR LESSON.

5. COMPLETE THE FOLLOWING:

Coding scales - own lesson.

5.1 *INTERACTION ANALYSIS*

BIAS (Brown's Interaction Analysis System)

	5 - Second Intervals
TL	
TQ	
TR	
PR	
PV	
S	
X	

(2½ minutes)

	5 - Second Intervals
TL	
TQ	
TR	
PR	
PV	
S	
X	

(2½ minutes)

	5 - Second Intervals
TL	
TQ	
TR	
PR	
PV	
S	
X	

(2½ minutes)

	5 - Second Intervals
TL	
TQ	
TR	
PR	
PV	
S	
X	

(2½ minutes)

5.2 *QUESTIONING*

Questioning	Question number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Higher Order															
Middle Order															
Lower Order															

5.3 *REACTING*

REACTING

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Praises															
Accepts															
Relates															
Uses															
Other															

WRITTEN LANGUAGE AS DIDACTIC MEDIUM: FROM PRINCIPLE TO TECHNOLOGY

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Unisa

1. INTRODUCTION

The utilization of written language as didactic medium is dependent on didactic design for effectiveness and learning success.

In the above thesis I consciously use terminology such as "written language" as opposed to "text"; "didactic design" as opposed to "instructional design". "Text" generally refers to written discourse in printed form. This I concieve of as an end product of a host of activities and processes that exist in the didactic process. "Instructional design" refers to an emergent discipline with practitioners mainly from the USA. Didactics however, has a tradition going back much further.

The notion of technology in this paper spans both didactic design and language in the written mode. Technology denotes knowledge rendered useful. It constitutes a fusion between the ideal and insight of theory and the practical man needs for competent functioning. This functional approach points to man's ability to organise and innovate.

Organization and reorganization depends on information - however, information of the "open" kind. To this end we have to be aware of "paradigm"; and I include both its wider Kuhnian meaning and that which explains a paradigm as a concrete conceptualization of an underlying idea or theory. Paradigm, philosophical assumptions and inescapable practical directions as a result of it, affect our thinking and application of Didactics and text design. Their usage is, within the productive environment of the lecturer at a distance university, the available technology.

The University has an increasingly important task to define its position towards and application of an assertive technology. Our concern is with didactic design and written language and instructional text. Within this area we have been already and we are increasingly being absorbed in the "mechanised" whole. We have the choice of what Weizenbaum calls succumbing to the imperialism of instrumental reason or reasoning about the instruments we use. We can misuse the technology we are offered. We can - to borrow a term from the world of surgery - offer prosthetics to our students. We can on the other hand offer instruction that takes full account of the exact nature of student, university learning and written language. This is a commitment we cannot escape from.

2. INSTRUCTIONAL DESIGN AND HIGHER LEARNING

One of the most pressing problems that has to be addressed is the lack of discrimination between higher learning and other modes of formal or incidental learning. The problem is compounded by the activities and materials used in this setting. Writing and text, reading and understanding, is of interest to psychologists, linguists, communication scientists, educationists and printing technologists. From these different perspectives many writers have contributed to the debate on the preparation of instructional materials. These contributions however also vie for prominence, acceptability and preference and finally application by the lecturer engaged in the preparation of instructional materials. Different perspectives and the fuller understanding they bring about on the phenomenon of distance teaching are legitimate enterprises. In each instance they stem from a stance within a particular modal sphere of reality. However as proposals for the conduct of distance teaching and the design of instruction and instructional materials they should be regarded with circumspection. They qualify and enhance the aspects of

instruction and development they primarily operate, in but their unqualified application does not serve either higher education or the student.

Higher learning aims at an encompassing education of university students as a direct and enabling service to society. The last mentioned indirect service and task of the university is primarily academic. Development of a scientific ability can be typified in the first instance by an analytic disposition. The analytic mind is aware of both universality and individuality. The analytic task finds expression in identification and distinction. University students are required to master these analytic skills but their mentors - when they propose strategies for instructing these students - at times fail to distinguish the modes of learning students have to master, the dimensions and qualities of analytic ability and simply the variety and extent of scientific existence.

Instructional design is reaching a high level of sophistication and eloquence through the research and proposals presented by Reigeluth (1983), Gagné & Briggs (1979) and Rothkopf (1981). What good does it do however when the very basis of the proposals fail to recognise the breadth and depth of human existence? One of the oldest but still one of the most important and internally consistent theories on instructional design was offered by Gagné & Briggs (1979). In this theory the five types of learned capabilities namely intellectual skill, cognitive strategy, information, attitude and motor skill is representative of a narrow and stilted view of the human condition. Yet it is known that analytic thinking - the essence of the logical modal sphere - shows an interlacement with other modal spheres and finds comprehensive expression in:

* cognitive control - the development of a system of logical thought and scientific thinking be it linear or lateral or contiguous, for all analytic enterprise in a variety of areas;

* logical symbolism - pertains to analytic and distinctive functioning within symbol systems and language;

* thought communication - communication with the thinking of others and communicating by expression of own thinking is essential for healthy scientific development;

* economy of thought - cognitive development can lead to effective application of logical and mental capabilities in which cumbersome reasoning has been replaced with sharp-edged cerebration;

* harmonious thinking - denotes balance and harmony in the application of thinking and describes that which provides an aesthetic quality to thinking;

* logical justification - development of analytic ability results in a critical ability that recognises the justifiable and rejects theory or reasoning that is not equitable;

* logical ethos and truth - development of analytical ability under the guidance of a science ethic brings about a love for scientific thinking and a willingness to be just and truthful in scientific thought and endeavour

* analytic certainty - faith enters into the argument in the demonstrable condition of scientific certainty that is arrived at when logical activity can be trusted to be true and valid.

Students function as human beings when they are involved in learning activities and the breadth of their functioning transcends all modal aspects of reality. The actual and possible human growth to which higher education is committed,

is rendered a disservice by adherence to instructional design theories that departs from a tripartite organizational matrix that recognises only three so-called "domains of educational behaviour". Even Bloom admits to serious questions about the validity of these simple distinctions that have been the vogue since ancient Greek philosohers expounded them (Bloom, et al, 1973:7).

In the development of the discussion on principles for designing instructional text I therefore hold to a conception of higher education and higher learning that is as yet merely qualified as theoretical-analytic development. Other aspects of a university education such as training for a profession or social commitment are however not ignored.

3. CHARACTERISTICS OF THE WRITTEN MODE

Nystrand avers that the functions of written language are very different from those of the spoken (1982: 8). Not only are we concerned with the functions of written language but we are also concerned with written language in educative and instructional function. In language generally form follows function and in instructional language form is determined by active and purposive design to fulfill the instructional function. But aside from the purposive manipulation of written language by lecturers, written language has unique characteristics that determine the extent of manipulation that can be effected and that act as parameters within which a theory of written instruction can be developed.

An important characteristic is the unique cognitive functioning brought about by written language as a result of what Vachek calls "quick and easy surveyability" (1973: 53). Its cognitive effect is quick silent understanding of the content mediated by the text. Continuous written discourse has a further notable characteristic in that the text serves as a stimulus for

inference generation. Writing established a different kind of relationship between the word and its referent, a relationship that is more general and more abstract and less closely connected with the particularities of person, place, and time. This decontextualization does not only indicate a third characteristic of written language but it also indicates a third type of learning. Written language contains complex morphosyntactic structures which are learned later in life, and which makes it an appropriate vehicle for the delivery of instruction to adults. The order and structure found in written language and the adult's preference for syntactic complexity seem to indicate that the two gravitate towards one another.

Lucidity is a characteristic of written language and refers to the abscence of more than one meaning and the metaphoric tendency of spoken language. Learner target group, level of application, content and scientific field as well as the writer's speech community are factors that qualify lucidity. But it remains that condition of text where legibility, readability and transparancy cause readers to be unaware of the text as text and they are absorbed into the world of its meaning.

Permanence and credibility are further characteristics of written language and it has opened possibilities as teaching and learning medium. Written language has the ability to postpone meaning or to extend meaning in time. This characteristic has been termed its "privative nature" Hirsch (1977: 2). Written language must secure its meaning in some future time in varied and unpredictable situations. This distinctive feature of written language poses the problem of composition with a view towards instruction and the isolation from any situational context.

Apart from the particular characteristics mentioned above a number of structural and functional features of written language present additional parameters for written instruction. They

are, in addition, added variables to take into account in the design of distance education. Among these, complexity is a notable feature. The interaction between the physical and ideal permanence of written language and the striving for credibility very often causes a complexity in written language which simply does not exist in spoken language. Apart from the difficulty it presents there is also the possibility of mediating extremely complex meaning or factual information.

Coupled to this feature is density. While complexity indicates the ability of written language to integrate separate but related matters, density refers to the ability to present related matters at a quickened pace. Density is a crucial feature of written language. It packs more content words into each phrase or sentence, it brings about a compactness and both a greater verbal density and a density of ideas.

4. LINGUAL DIDACTIC PRINCIPLES

In a recent study, Van Deventer 1983, lingual didactic principles for the design of written instruction for tertiary distance education were identified.

The principle of structure indicates a didactic structure in which the application of written language and the operational and functional characteristics of written language are not at variance. This principle determines that the cognitive effect of written language should not be nullified by complexity or that density in the text should not be sought at the expense of lucidity.

Structure also indicates all the relevant components and constituents of the instructional situation. The written lecture represents a definitive set of the lecturer's knowledge on a particular theme in other words his/her psychological structure. Furthermore the exposition contains factual

information regarding the micro and macro structure of particular discipline content. It is further meant for the reference structure of the student.

In accordance with the scientific emphasis in tertiary education, formality is indicated as the second lingual didactic principle. Formalizing text, situation and content has the psychological effect of certainty and confidence. Formality pertains to the selection and definition of symbols to carry precise meaning.

The interlacement of language structure with all aspects of human culture and endeavour, the functioning thereof and the cultural foundation of university teaching indicates interwovenness as a third principle. Integration of all relevant aspects in the design of the lecture is wanted. Integration actively strives at relating to the existing knowledge of the student. Integration takes into account text form and function by differentiating between text forms such as imperative text, demonstrative text, and informative text within the obligatory instructional text. It is dynamic in its promotion of insight or logico-semantic-relations or explanation or sequences or change in strategy. It recognises specific applications in different phases of the lecture. It promotes an individual instructional design or particular style or unique approach.

Application of the principle of interwovenness brings about an instructional design that is specifically engineered for a particular science or discipline. Apart from factual knowledge about a specific discipline it poses the necessity of specific discipline related didactic knowledge and skills as well as technical language knowledge and skills. The insistence on technical terminology stems from a fundamental point that the development of science necessarily involves coherent language change as a result of the inability of language to do its work adequately.

The fourth principle is termed intentionality and does not merely indicate resolution. It also denotes that written instruction has to fulfill its purpose at a time and under circumstances removed from that when it is designed. Post operatively a principle has the function of a criterion and the application of this criterion tests whether the intended design actually resulted in the end product. The application of this criterion is very important for apart from all the benefits of written language it also has the negative result that because writing is time consuming ideas can pass and the text can become stilted or unclear or incomplete. An important distinction in accordance with this principle would be that the instruction is meant to be written instruction. In such a design irrelevant traces of oral instruction would be consciously guarded against. For instance fillers abound in oral education but are out of place and unnecessary in written instruction. Lexical variants, post-completions, vagueness, unnecessary repetitions or meaning variants are contraproductive (De Beaugrande in Nystrand (Ed.) 1982: 242 - 247).

The commitment of distance university teaching to the development of the individual, and his/her discovery of scientific fact and universals through written language and distance education, indicate relevance as a fifth didactic principle. It poses the problem of relating the written instruction to all aspects of the personality and being of the student. It admits to the fact that the lecturer communicates more than mere fact or information to the student in his/her teaching.

The sixth didactic principle for tertiary education through the written language mode is clarity. Scientific activity invariably aims at clarity. All theory aims at isolating the phenomenon from its surrounding excess, particularity and diversity. Clarifying starts as a pre-instructional operation and strategy when objectives are written down. It functions in the final instructional design in both legibility and readability.

Structure, formality, interwovenness, intentionality, relevance and clarity are taken as principles for the design of tertiary, distance education by means of written language. These principles can be seen as intersecting points when these very different entities are jointly employed. In this application a principle remains a relatively constant universal unit that can be used in varied situations by a competent lecturer who is accountable for the "correct" or "incorrect" application of the possibilities offered by the principle.

Whether all of the above principles can be held to be true and valid further research and time will tell. Research evidence independent of the research that led to their publication, and research evidence since, have established the validity of some of them. In time additional principles to act as a theoretical framework for written instruction at the university level shall be evolved. At present however, there is both the need for precise guidelines to the practicing lecturer, and an emergent technology based on principles anchored in a single modal aspect of reality that should give cause for concern to theorists in didactics or instructional science. The purely pragmatic or utilitarian may be expedient but I doubt whether it serves the fundamentals of university education.

5. FROM PRINCIPLE TO TECHNOLOGY

A technology of written instruction describes a process to design a specific and exact teaching-learning-instrument that is both reliable and which can be validated. It is further indicative of an array of strategies and classes of linguistic performance to exact cognitive functioning, behaviour, skills, attitudes and dispositions in accordance with the demands of higher learning.

Instructional theorists offer a technology of written instruction for application by practising lecturers. The problem with these models is that they remain general didactic models in the sense that they lack precision and individualization.

To overcome this problem the principle of intentionality seems to prescribe that the technology for written instruction becomes my (the lecturer's) technology. The systematic application of the conditions, constraints, possibillities and principles of the factors he/she is concerned with is required.

It remains the task of the individual lecturer or the team jointly responsible for the delivery of a course, to use and individualize technology. Unqualified use of technology and application of the prescription of theory or model should however be discouraged. Useful "filters" exist that will enable the lecturer to refine the technology that is to be employed. They are in the form of principles for the components that jointly constitute tertiary distance education by means of written instruction. I shall illustrate this viewpoint by means of a number of examples.

John F. Carter (1985) has contributed greatly to an understanding of written instruction. His insistence though to employ as many potentially facilitative educational devices as can be thought of (Duffy & Waller (Eds) 1985: 149) is in opposition to the didactic principle of integration that requires the lecturer to integrate devices, media and procedures in accordance with objectives and necessity. When he, on the other hand, groups together as orienting devices objectives, headings, key words and advance organisers, it is in accordance with text principles and the nature of written language (op. cit., 150). Judging on the basis of linguistic and cultural principles and what is known about symbolism we have to disagree again when he offers the "colloquial wisdom" that a picture is worth a thousand words (op.cit., 151). The lecturer will then apply drawings, diagrams, flow charts and algorithms with circumspection because so many of these require a thousand words.

As a final reference to Carter we take note of his advice to lecturers to cause the student to interact meaningfully with the text through activities designed to induce processing that will facilitate understanding, learning, and retention (op. cit., 152). It means adhering to psychological and reading principles that state that students will only learn at a meaningful level when the information-processing requirements that were incorporated in the text by design, demand that they do so.

The application of these filters presupposes knowing about them and their being readily available. Organizing and classifying features, procedures, stages, techniques or devices is a very necessary intellectual exercise when effective instruction is intended. By way of an example we may consider a number of factors to be taken into account when the exposition stage in the written lecture is designed.

* Levels of processing refer to the relative difficulty of the text.

* The usage-sequence principle is that all other things being equal, a sentence should be easier to understand if it presents information in the order in which it is used in comprehension (Dixon 1982: 70). The significance of this is that structure is not only to be considered for the lecture as a whole. Within the lecture structure is determined by the physical organization of information in the sentence.

* Schemata and comprehension. Schemata are presented in the selection and interpretation or even the distortion of information and from the students view in the recall, reconstruction and analysis of information.

* Thematic progression indicates a principle of text struc ture that states that existing or given information should preceed new information within a sentence.

These four examples of factors to be considered is ample to cause the realization that the more sensitive a lecturer is to his/her audience and to the resources of the written language for expression, the more effective his/her education will be.

* * *

The Evolvement of a technology for written instruction is an ongoing process. Valuable contributions have been made by theorists such as Romiszowski (1986), Van den Berg & Van Daal (1983), Jonassen & Kirschner (1982) and others mentioned elsewhere in this paper. The most significant contribution to a technology of distance education by means of written language will however come from the practical written instruction planned, designed and constructed daily by lecturers at all levels because their's is instructional design within and for learning of a particular science or discipline.

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COMPUTER-AIDED INSTRUCTION IN QUANTITATIVE MANAGEMENT

- PART I -

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1. Introduction

The days of the sliderule and the logbook are finally over. The rapid development of computers and associated technology since the fifties, has had far reaching effects on almost every area of current life, and last but not least, also on training and teaching.

Computer-aided teaching, especially with respect to mathematical subjects, has aroused great interest. Skinner's linear programs were characterised by dividing up the curriculum into small units which followed each other logically in small steps and to which the student had to react correctly at each step. This led to the branching programs of Norman Crowder (1958) where the student's answer or reaction determined his further course through the program. Crowder's technique led to program systems such as PLATO and SOCRATES which can be run on mainframes and on micros.

The traditional approach to computer-aided instruction rests on the use of mainframe computers and/or large networks of micro-computers. These systems are very expensive and impractical as far as distance tuition is concerned where the students are spread over a very large geographical area.

However, computer-aided instruction need not be limited to mainframes and micro-computers. Pocket calculators have developed so much that far more than the basic mathematical functions are now available on a relatively cheap calculator. Some of these calculators lend themselves favourably to computer-aided instruction.

A big problem with mathematically-oriented subjects is that students often have an inherent fear of anything that looks mathematical. They tend to

convince themselves quickly that they will never be able to master mathematics. This causes a resistance against these subjects.

Residential universities allow for constant personal contact between tutor and student. Problems can be solved immediately in the lecture room and care can be taken that the student develops a proper understanding. In this fashion the student can be assisted to overcome his fear of mathematics.

With distance tuition the imparting of mathematically supported disciplines is a unique problem because of the lack of personal contact between tutor and student. However, computer-aided instruction can be applied with success in this area to fill this gap. By acquiring useful mathematics students can be convinced that they are indeed capable of solving mathematical problems.

Unisa's Department of Quantitative Management has a new approach to computer-aided instruction which relies on the use of a pocket calculator and which forms a very effective and much cheaper alternative to the traditional approach.

The Department presents a three-year course in Quantitative Management. Quantitative Management comprises procedures for solving problems where man-machine interaction leads to the taking of concrete decisions. The student is taught the necessary mathematics to enable him to translate problems which occur in many areas into mathematical notation and to solve them. We are not talking about recipes, but about the acquisition of a way of thinking, a philosophy aimed at problem-solving and decision-making.

2. Resistance to mathematically-oriented subjects

Students display a fear for mathematically-oriented subjects which is not present in subjects such as History or a language. In their defence they state that they have no aptitude for mathematics.

Carroll defines aptitude as the amount of time required to master a learning assignment. According to Vrey (1979, p.284) both Bloom (1964) and Hunt (1961) found indications that aptitude in a subject as measured with the available methods, is not absolutely consistent. Improvement was found with improvement in environmental factors and with the experience of successful learning. It would thus appear that if a student has enough time at his disposal, is participating in the learning process and experiences meaning in it he can be successful.

Attitude refers to the inclination of the student to learn. Apparently attempts to foster a positive attitude towards mathematics with pupils have not yet been sufficiently successful and they begin their university careers with a negative attitude towards mathematics. There are several reasons for this.

Students or pupils are not interested in mathematics because it is presented in such a way that it does not provide personal satisfaction and there are not sufficient opportunities for using their own initiative.

The ideal is, according to Du Plessis (1980, p.50), to not only make students the passive receivers of knowledge, but rather active discoverers. In a study conducted by Callahan about possible reasons for positive and negative attitudes towards mathematics it clearly appeared that a positive attitude develops because of the realisation that mathematics has practical aspects and that it is essential for man's existence (Du Plessis, 1980, p.52).

Mathematics teachers often omit to point out these aspects. For the child mathematics is merely a difficult subject which he has to pass as a prerequisite for certain further studies, but apart from this, it has no meaning to him.

Dekker (1965, p.30) pointed out that if tuition is given in such a way that students gain insight into the curriculum, the chances are very great that they will transfer the acquired facts and apply them to other areas. If mathematics is taught in a recipe fashion instead of using a methodology which rests on insight and understanding, the result is an inability to apply mathematical thinking to other areas of study.

School mathematics is too theoretical and there are too few teachers who can assist pupils to develop a logical thinking process. Pupils are prepared to pass examinations. According to Dekker (1965, p.96) a teacher conforms to set standards if his pupils are successful and achieve good results in examinations.

The hierarchical structure of mathematics gives rise to a concept being expanded every year. If the prior concepts are not fixed firmly the student cannot assimilate the new material. This causes a series of failures and the child becomes disheartened.

Time is an important factor in the classroom situation. The activities of one period, comprising reviewing of work done and the explanation of new work, are too much. The slow learner suffers and his abstract reasoning abilities are not developed. Often the teacher does not have enough time at his disposal to allow the slow learner to develop his full potential.

The school system forces the teacher to work through the curriculum in a certain period of time. Pupils cannot advance at their own rate. In many schools classes are not differentiated and the heterogeneous background of the students causes the poorer student to fall behind.

Apart from this the difference between the presentation of primary mathematics and high school mathematics is too large. Primary school mathematics is recipe-oriented. At high school level the student is expected to be able to think and personal attention is less. If he has not had the necessary stimulation in primary school already, he will experience adaptation problems. An easy solution, especially in the absence of personal attention on the teacher's side, is to throw in the towel.

Parents also often have a negative influence on their children as far as mathematics is concerned. Women especially believe that mathematics is only for boys and very clever girls. Visser (1985, p.91) mentions that increasing pressure is brought to bear on girls during adolescence to conform to certain sexual norms. If mathematics is presented to the girl as a male field of study which will not be of real importance in her future life, then it is clear that she will show a negative attitude

towards the subject and fare worse. Children, especially girls, do not get the necessary support at home and spend their school careers with the illusion that they do not have an aptitude for mathematics.

It is thus not surprising that many students have a negative attitude towards mathematically-oriented subjects.

There is no mathematics prerequisite for BCom students at UNISA. In 1984 693 students enrolled for Quantitative Management I. In this group there were 478 students who passed matric mathematics.

From the table below, we see that 59,11% (age known) of students are in the age bracket 25-34 years. School mathematics curricula changed so much that these students are now confronted for the first time with certain mathematical concepts which are presented in primary school these days. These students are aware of this fact and because of it they can develop a feeling of inferiority about their mathematical ability. 44,13% (age known) of the students are 30 years or older and have had no contact with mathematics for ten years or more. Because of the age factor, they have little or no self-confidence in their mathematical abilities.

QMN100-M Students classified into age

Age	Number	%
Unknown	199	28,72
Under 18 years	11	1,59
19 - 20 years	13	1,88
21 - 22 years	31	4,47
23 - 24 years	49	7,07
25 - 29 years	172	24,82
30 - 34 years	120	17,32
35 - 39 years	60	8,66
40 - 44 years	26	3,75
45 - 49 years	7	1,01
50 - 54 years	5	0,72
Total	693	100,00

3. An argument in favour of the use of pocket calculators

The matter of the use of a pocket calculator for acquiring mathematical skills has received attention in various articles. It is interesting to note some quotes from articles which appeared in the Arithmetic Teacher and the Mathematics Teacher.

"Low achievers generate new enthusiasm for mathematics because they finally have no fear of being unable to perform the necessary calculations. Hand-held calculators stimulate interest in and facilitate the teaching of mathematical concepts - more time is available to teach mathematics in depth." (Shumway, 1976).

"Correct answers depend on insight into the problem in order to choose the proper operations with the necessary numbers in the required sequence. The calculator can present dramatic, attractive and speedy opportunities for discovery, demonstration and reinforcement in the general mathematics classroom with even the lowest-ability student. In fact, the slower student, usually resistant to deductive logic and abstractions, yet too sophisticated for arrays of ducks and portions of pies, can profit most." (Machlowitz, 1976).

"Tedious and unnecessary calculations can consume time and destroy a child's interest in mathematics. When the calculator is used to eliminate this drudgery, more time will be available to focus on problem-solving skills." (Gawronski & Coblentz, 1976).

The experiences of the Department of Quantitative Management at UNISA corroborate the above.

Since UNISA is a distance education university, the telephone is the most important link between lecturer and student. Typical calls at the beginning of the academic year begin as follows: "I last did mathematics 10 years ago."; "I have Std. 8 mathematics, will I ever be able to do this stuff?"; and more desperately, "I have never been able to do sums and now the whole study guide is full of them". Then, later in the year, the positive statement: "Now, for the first time I know how compound interest

works"; "I never knew that it was so easy!"; "The fact that the computer does all my calculations for me has made me understand higher order functions for the first time".

It would appear that there is more time for the student to assimilate concepts. The speed of the pocket calculator and its ease of use ensure that he can work out enough examples and fix the subject matter in his mind firmly. The pocket calculator makes the generation of realistic examples and exercises easy. This results in students seeing practical applications more easily and having a better "feeling" for the study material.

4. Study material

The study material for Quantitative Management I consists of two study guides and a particular prescribed pocket calculator.

Study Guide 1, which must be worked through first, is aimed at teaching the student a wide variety of basic arithmetic, numeric and mathematical skills. It contains useful mathematics and its application is emphasized. Important mathematical concepts are studied in full detail. The importance of interaction between the student and his/her calculator is underlined.

The second study guide leads the student in detail into the underlying philosophy and approach to Quantitative Management. A number of standard models and methods which are often used in practice are studied here.

The first study guide is divided into four chapters which are subdivided into subjects. Each subject is then again divided into frames.

In this fashion the chapter about equations is divided into two subjects: "Equations" and "Inequalities". The subject "Equations" is subdivided into

(i) the algebraic method of solution of equations in one variable;

(ii) numerical solution of equations in one variable;

(iii) simultaneous equations in two variables;

(iv) multi-variable systems of linear equations.

In each frame the subject matter is illustrated with examples. A number of exercises must be worked through after every paragraph before the student may advance to the next paragraph. At the end of each frame, there is a summary of the frame, an evaluation exercise which covers the whole frame and a complete set of solutions for all the exercises in the frame. Similarly, in the second guide where for example linear programming models and their optimisation are discussed, everything is illustrated by means of examples, with a number of worked-out exercises at the end of the relevant chapter.

The pocket calculator which is prescribed for both the first and second years of study is the SHARP EL-5150. It has a computational mode as well as a statistical and programmable mode.

The display can show up to 24 characters and calculations are not executed before the [=]-key is pressed. The advantage of this is that expressions are shown in their entirety and can be inspected before an answer is obtained. Cursor keys can be used to change workings or formulae in the display. The delete and insert keys make deletion and addition possible. The replay key allows the original operation to be recalled to the display after an answer has been obtained.

Over and above the 26 available memory registers, the calculator has logical and trigonometric functions as well as common mathematical functions built in. With a single key stroke, results can be displayed in fixed point notation, scientific notation and floating point notation.

In fixed point and scientific notation, the calculator can be set to display answers to a given number of significant digits. Up to nine specific digits can be specified. Although only a limited number of digits are displayed, the calculator retains full accuracy in its memory and the student can rest assured that an answer to four decimal places for example will have been correctly rounded.

In the programmable mode there is a capacity of 1454 steps and 99 algebraic expressions can be programmed. Each of these 99 programs can be given a name or title which can be up to 29 characters long.

Whenever a programmed formula is used in the computational mode, the [TITLE]-key is used to recall the relevant formula for calculation purposes.

In the programmable mode, the progra for the solution of a quadratic equation will appear as follows:

01 : QUADRATIC

M : [1] d >= Ø - Y —> [[2] >] - N —> [3]

[1] : $d = b^2 - 4 \times a \times c$

[2] : $x_1 = (-b + \sqrt{d}) \div (2 \times a)$,

$x_2 = (-b - \sqrt{d}) \div (2 \times a)$,

$\alpha = -b \div 2a$

$\beta = \alpha^2 \times a + \alpha \times b + c$

[3] : $\alpha = -b \div 2a$, $\beta = \alpha^2 \times a + \alpha \times b + c$

Here various features are used to advantage. Students need not spend unnecessary time memorising formulae. However, they must understand the formulae before they will be able to program it. They also learn the principles of programming. Each program must first be drawn as a flow chart and it must be clearly shown in which "subroutines" the "main program" obtains its information. Not only is the student forced to think in an organised manner, but this also serves as preparation for Quantitative Management III where he must use BASIC to program micro-computers.

Quantitative Management II comprises 2 papers involving 3 study guides. The study guide for the first paper, QMN201-R, is a continuation of study guide 1 of the first year, QMN100-M, with similar style and layout. The second paper, QMN202-S, comprises two study guides. Both of these describe standard models and methods which are used frequently in practice.

5. Modus Operandi

To be confronted immediately with formulae and symbols when opening a handbook is enough to put any student off. Lecturers in mathematics and mathematically-oriented subjects are well acquainted with the phenomenon of symbol-shock in their students.

To avoid symbol-shock the student's understanding and feeling for numbers must first be developed before he is exposed to formulae.

According to Curzon (1985, p.57) Bruner emphasized that students must be taught to develop their abilities to the fullest. They must be taught **how** to analyse problems, to look for relations and structures and how to find solutions. Students must acquire a skill.

Man learns best through experience. After a number of examples have been worked through, the common relations can be recognised and a general formulation of the theory can be attempted. Repeated exercise on the computer ensures that the student can handle the inductive leap from numbers to symbols with ease, because he learns by discovery and gets satisfaction in finding solutions on his own.

The important understanding of the general concept must always be preceded by knowledge of specific instances of the concept (Bekker, 1965, p.54). The pocket calculator allows the student, for example, to understand inverse functions by experiencing the process. The original function begins with a number and supplies a second number. The inverse function changes the second number back to the original.

For students who were last exposed to mathematical theorems ten years ago, the distributive law of multiplication over addition is a strange concept.

The problem is solved as follows:

The student must use the calculator in order to determine whether the operation on the left-hand side of the equal sign and that on the right-hand side of:

$$12{,}3 \times (-3{,}4 + -6{,}6) = 12{,}3 \times -3{,}4 + 12{,}3 \times -6{,}6$$

give the same result.

After several such exercises, he is asked whether he has noticed anything. After this the law is formulated.

The calculator has the advantage that the 26 memory registers are alphabetically marked. Numbers can be entered by using the [STO] key and can be recalled to the display using the recall key [RCL]. Students are taught how to store numbers in different registers, to recall them and to execute operations with them.

In this manner the number 6 can, for example, be stored in A and 5 in B. When [A] [+] [B] is pressed, A + B appears in the display. When the [=] key is pressed the numerical answer, 11, is displayed.

It should be noted in particular that this a typical example of learning by discovery. The student suffering from symbol-shock now discovers that there is no mystery in the expression A + B or a + b - it only depends on the values which are held in registers A and B. This is an important breakthrough in understanding the concept of variables. Variables are very important in translating verbal problems into mathematical terms. To allow the student to get on friendly terms with this concept, especially in distance tuition, is difficult. However, repeated exercise with simple problems, sets this firmly in his mind. When the student comes to the complicated linear programming problems, translation is no longer a problem. To determine which are the dependent and which the independent variables of a function also becomes easy.

One of the most important requirements for successful studying, namely involvement in the studying process, is now satisfied. The calculator which initially was a disorder of numbers and letters, now becomes a trusted companion which helps to assimilate strange concepts such as that

of the variable. Now it is easy to see that the distributive law of multiplication over addition is nothing other than:

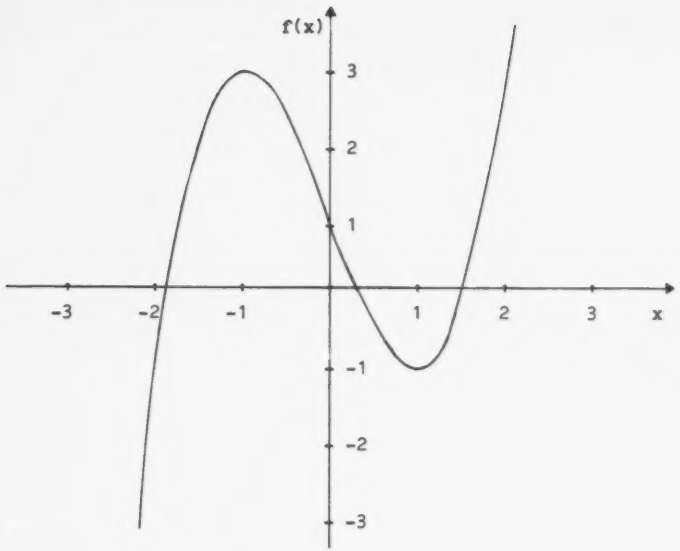
$$A \times (B + C) = A \times B + A \times C$$

According to Dekker (1965, p.31) functional thinking is one of the fundamental principles in mathematics - "If this functional concept is stressed it helps to emphasize coherence of various sections." Dekker (1965, p.41) also mentions various researchers who are attempting to make the functional concept central in study material. If a student can think functionally, then he has learnt to work with "the world of the idea and the abstract concepts."

And yet the university student still has many problems with the functional concept. In order to help him with this, he first gets enough exercise with the calculation of simple and compound interest formulae. Once he has mastered these, he is shown the application of functional notation to these formulae. His pocket calculator has a special function key with which he can program a function after he has determined its structure.

To expose a BCom first-year student to a technique of nonlinear programming which is presented for BSc second-year students, sounds rather daring. It is here that sketches can be especially useful and the inductive manner of working comes to the fore. An example from the study guide will serve as illustration. The student must determine the roots of the function $f(x) = x^3 - 3x + 1$ accurately to four decimal places. The roots are the values of x where the function takes on a zero value.

The function is keyed into an available slot in the programming mode. In the computational mode, when the [COMP]-key is pressed, the display shows X = ?. If -3 is keyed in, the function value, -17, is displayed. In this manner function values and different x-values can be found and a graphical representation can be made.



Since the function value at x = 1 is negative, and positive at x = 2, there must be a root of the function somewhere in the interval (1; 2). A guess for the root is the midpoint of the interval, 1,5. Here the function value is -0,25. It is thus logical that the root must be in the interval (1,5; 2).

The midpoint of the interval (1,5; 2) is 1,75 with a resulting function value of 1,109375. The new interval which contains the root is thus (1,5; 1,75). The student repeats this process until he has determined an interval in which the function value at the midpoint is as close as possible to zero.

Now he sees the pattern. He considers an interval (a; b) of which the midpoint is $c = \frac{a + b}{2}$. If f(c) < 0 then a = c and if f(c) > 0 then b = c. Only at this stage is the student informed that this step-by-step method is actually a new mathematical concept, namely that of an algorithm.

He can make a diagram of the method and enter the algorithm in a suitable slot in the programmable mode. He is now able to determine the roots of any function quickly and accurately by merely changing the function that is programmed in the calculator.

He obtains the satisfaction that he has mastered a technique - he is now able to determine the roots of a continuous function. He cannot program the algorithm and use it unless he has understood the principles underlying it. In each problem he must choose the starting interval himself without drawing the function every time. Thereafter he must be able to solve a problem such as: "If the revenue function for the 'Perfect Pram' is $R(x) = 200x^{0,85}$ and the cost function is $C(x) = 150x^{0,8} + 10\ 000$ what is the breakeven point?" before he can progress further in the guide.

In Quantitative Management II the student is encouraged to master differential and integral calculus as well as interest calculations and then to deduce the general rules himself. These rules are engrained by means of various problems with practical applications which the students must work through.

The study guides for the second paper are worked through alternately with the first study guide. As soon as the necessary mathematical concepts in QMN201-R have been mastered, further practical applications from the other study guides are presented.

The student is also led to explore the statistical mode of his pocket calculator and to fit a linear regression line with confidence and insight.

The concept of a function is used intensively in the second year.

Working through the mathematics of finance the student is encouraged to derive the formulae for annuities for himself and to program these as functions in his SHARP. An example is the function

$$f(I, J) = ((1 + I)Y^{X}J - 1) \div (I \times (1 + I)Y^{X}J)$$

where I is the interest rate and J the number of payments. The student can then calculate his monthly payment on a mortgage bond with ease should he

wish to buy a house or a car on hire purchase. He can experiment himself to find out which pay-off period or interest rate would be more worthwhile and can even consider inflation or a subsidy in his calculations.

In calculus the two fundamental concepts, namely differentiation and integration, are introduced in an effective manner by using the concept of a function. The derivative of a function is defined as the limiting value of

$$\frac{f(a) - f(b)}{a - b}$$

as b approaches a. By inspecting this expression numerically after the relevant function has been programmed into the SHARP, a rule can be derived for the derivative. The Riemann definition of the definite integral, according to which the areas of successive strips under the function are summed to approximate the true area (which is also the limiting value) is also suited to introduce integration by using the function concept. In this way the student acquires an intuitive feeling and insight as to the true meaning and application thereof.

Quantitative Management aspires to instill a way of thinking aimed at the solution of problems and here insight is of critical importance. Ausubel (1968, p.536) states very strongly that insight is not a sudden phenomenon - "... it follows a period of fumbling and search ...". The computer has the advantage that this period can be shortened appreciably. Considering the nature of his circumstances the UNISA student has only a limited time for study at his disposal. To let him struggle with unneccesarily difficult operations will definitely dampen his interest.

The pocket calculator makes it possible to work through many examples quickly. The programmability allows formulae to be stored. Formulae can be represented as they are written in the guide. The student thus only has to identify the type of formula with which he has to work.

Since the computer eliminates pen and paper calculations much more time can be spent on developing concepts. Application possibilities are increased and expanded. The student is forced to start thinking on a high level. To

get his calculator so far as to do all the donkey work for him he has to understand the concepts before he can program them.

In mathematically-oriented subjects it is important to translate problems into mathematical notation. The student's repeated use of memory registers for storing numbers, drive the idea home that one register can be used for different numbers at different stages. The concept of a variable is brought home in direct manner and it is precisely this idea which is so important in translating.

The successful result of teaching is a series of successful learning events. Behr (1980, p.63) defines that a successful learning event occurs if the subject can do something which he could not do before. It is quite amazing to see that the student who complained at the beginning of the study year: "I have never been able to do sums" at the end of the study year is able to tackle and successfully solve a problem which requires extensive knowledge.

The student at a residential university has the advantage of personal contact with his lecturer and fellow students. UNISA students are often isolated from other students and are dependent on correspondence and telephone calls for contact with their lecturers. The manner in which study material is presented is therefore very important. In the Department of Quantitative Management the study guides are written in an informal manner and involve the student as an individual. He gets the feeling that the lecturer is conversing with him as a person. He becomes involved with the optimisation of Mr Sampie de Boer's farming as well as with the distribution of political pamphlets in the Marico bushveld. Tutorial letters containing the solutions to assignments follow this trend and students react positively towards this.

6. Summary

Pocket calculators are used all over and by everybody these days. Technology brings about quick and effective methods which raises the question whether there is still a need for pen and paper calculations. Except when its battery must be replaced a calculator does not tire, is not lazy, does not get excited or annoyed.

A mathematically-based subject which requires repeated exercise for its mastery can use the pocket calculator very well. The question arises whether the pocket calculator makes the human brain lazy and loathe to think. In Quantitative Management it has been proved that careful planning of a course not only completely excludes this possibility but rather has the opposite effect.

In Quantitative Management the optimal use and extension of the student's ability is pursued with the aid of computer-aided instruction. The student's successful handling of a pocket calculator is dependent on the understanding and insight that he develops. Learning based on discovery is aimed at, with the result that the pocket calculator has become an extremely effective teaching aid.

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COMPUTER-AIDED INSTRUCTION IN QUANTITATIVE MANAGEMENT

- PART II -

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1. Introduction

When the Department of Quantitative Management became independent in 1983 and moved from the Faculty of Science to the Faculty of Economic and Management Sciences we were placed in the position of having to develop a brand new full-fledged three-year undergraduate course in Quantitative Management for BCom students - something which had not existed before in South Africa and for which there was a great need.

We naturally asked ourselves what we want our students to acquire during the three years that they are in our hands. Our idealistic answer was - students who have a sound academic basis and who have mastered certain mathematical and modelling skills which can be of immediate and future practical use to them.

With these objectives in mind we developed our course in Quantitative Management. The paper "Computer-Aided Instruction in Quantitative Management - Part I" describes how the first- and second-level courses address our objectives and how a programmable pocket calculator is used to aid the learning process. This paper conveys what is done in the third-level course and how a micro computer is used as a teaching aid.

2. The curriculum of the third-year course in Quantitative Management (QMM300-T)

Students entering the third year have passed the second year and have usually been cured of their symbol-shock. They are able and proficient in manipulating symbols and have reached a satisfactory level of mathematical competence. What they still require are modelling skills. They also need to be prepared for what will be expected of them once they enter practice.

To attain this, the following three third-level papers are presented:

QMN301-U : Financial Modelling
QMN302-V : Applied Linear Programming
QMN303-W : The Design of Optimising Algorithms

In the first paper, QMN301-U, the emphasis is on modelling - how to transform a practical problem into a realistic symbolic representation of the problem which can be manipulated using the tools taught in QMN100-M and QMN200-Q. Most of the problems presented are of a financial nature.

QMN302-V covers one of the most used Quantitative Management techniques, linear programming. Students are taught to build and solve linear programming models. Great emphasis is placed on model building and on the interpretation of solutions obtained. Some of the theory underlying the technique are studied in detail so as to enhance the student's understanding of the processes involved in a solution.

QMN303-W is a more theoretical course and covers nonlinear models and techniques. A wide range of techniques are introduced. It is pointed out how the various techniques were developed to make up for the shortcomings of others. In this way students attain knowledge and skills that can not only be of immediate use, but also prepare them for designing their own algorithms when a suitable one does not exist.

3. The need for a micro-computer

Access to a micro-computer is a prerequisite for registration for QMN300-T. It may be asked whether this is really necessary and if it is not too restrictive.

The use of a micro-computer is an integral part of the third-year course and serves three purposes:

Firstly students are introduced to the technology that will face them in practice - any unfounded fear that they might have of computers is allayed by many hours at the keyboard. Secondly the computer enables us to shift

the emphasis away from teaching algebraic and arithmetical skills towards teaching modelling skills. Thirdly the computer helps the student to learn actively and investigatively, getting immediate feedback from any possibility that he may explore.

It will be argued later that the calculator used in the first two study years can not be used to the same end.

The registration prerequisite may seem restrictive, but this is not the case, since we do not prescribe a specific model of computer but only a list of minimum requirements to be met. Furthermore, at the end of 1984, when the first group of students completed the QMN100-M course, we sent out a questionnaire re the availability of micro computers. Students were asked inter alia to indicate whether they had access to a computer e.g. at work, owned one or intended to buy one.

297 of the 693 students, i.e. 43%, returned the questionnaire. All indicated that they intended to major in Quantitative Management. Only five students (less than 2% of respondents) indicated that they did not have access to a computer, did not own one and did not intend buying one.

In addition, largely due to our initiative, the micro-computer laboratory for students was established in Pretoria and machines were also made available at the regional offices in Cape Town, Durban and Pietersburg.

It can therefore be assumed that access to a computer does not pose a major problem and that interested students are not put-off because of this, but rather have, as we experienced, the opposite reaction.

4. The role of the micro-computer in QMN301-U

The objective of this paper on financial modelling is to give the student a feeling and understanding of the modelling process and to help him master to some extent its major technological aid, the computer. In this last respect the objective is not to train competent computer programmers but rather intelligent computer users.

Three major topics are covered, viz.

(a) modelling with spreadsheets

(b) modelling with BASIC

(c) models and modelling for decisions.

A spreadsheet (see figure 1 below) can be considered as a very large table with numbered rows and columns. The "block" formed by the intersection of a row and a column is called a cell and is identified by the numbers of the row and column concerned. The cells of a spreadsheet can be filled with three basic kinds of information: text, numbers and formulae. When a formula is entered into a cell, the actual value of the formula is displayed.

It is assumed that students have no previous computer experience. As most spreadsheet packages are very easy to use and the manuals provided by the suppliers are generally very readable and lucid documents, spreadsheeting serves as an excellent introduction to using and programming a computer. Furthermore the nature of spreadsheet programming lends itself pre-eminently to modelling financial situations.

As an example consider the following simple problem. Suppose a company produces and sells a single product. Their fixed cost per month is R70 000 and the variable cost per unit made and sold is R12. If they price a unit at R20 they will be able to sell 10 000 units; at R18 a unit they will sell 15 000 units and at R14 a unit they will sell 20 000 units. They want to know what selling price will be the most profitable. They also want to know how the solution will change if the fixed or variable cost changes.

To tackle this problem using a spreadsheet, the following may be entered into the cells of an empty spreadsheet:

	A	B	C	D
1	Fixed cost	70 000	Variable cost	12
2				
3	Selling price	20	18	14
4	Units sold	10 000	15 000	20 000
5				
6	Sales	+ B3 * B4	+ C3 * C4	+ D3 * D4
7	Cost of sales	+ B1 + D1 * B4	+ B1 + D1 * C4	+ B1 + D1 * D4
8	Gross profit	+ B6 - B7	+ C6 - C7	+ D7 - D6

Figure 1 - A typical spreadsheet

The actual values of the formulae entered into cells B6 to D8 will be displayed on the video screen and the selling price yielding the highest profit can easily be discerned.

A sensitivity analysis can be performed on this set of data by appropriately varying the contents of cells B1 and D1. For example if D1 is changed to 13, the values displayed in cells B7 to D8 will immediately and automatically change accordingly and the effect of this change on the decision as to what price should be charged, can be assessed.

Students are encouraged to play around with their spreadsheet models by asking themselves what-if questions, and not only finding solutions but also trying to understand the logic of the solutions and to discern patterns. If a calculator had to be used to obtain answers to what-if questions, I doubt if students would have responded to these suggestions and even if they had, if they would have learnt anything from the tedious exercise! (Not to mention the outmoded practice of calculation by hand!)

While learning about spreadsheets, the students acquire many basic concepts used in programming. For example, a spreadsheet cell is similar in concept to a program variable. In this way learing to set up a spreadsheet program paves the way for learning to program, which is the basis of the second major topic covered in the course.

It is necessary to learn programming, as a practising Quantitative Manager is bound to come up against problems requiring models which are beyond the scope of the standard software that is available. In such cases he should be able to write a simple program himself or to communicate intelligently with a computer programmer if more complex programming is required.

BASIC is used as the programming language. Althoug BASIC has structural shortcomings it suits our purpose very well. Firstly, it is available on all micro-computers, usually at no extra cost. Secondly, it is an easy language to use because of its simple structure and straightforward (in most cases) syntactic rules. Also, most students use interpretive BASIC which makes troubleshooting easier and has certain educational advantages over most compiler BASIC versions.

As the students develop their programming skills, their modelling skills are also developed and vice versa. Some of the modelling approaches that are taught in this way are network analysis, dynamic programming and input-output analysis. Some of the related techniques are rather complex and require cumbersome computations of a repetitive nature. Using BASIC to implement the models, removes the need for performing the tedious arithmetic and places the emphasis on understanding the concepts. And once a model has been computerised, it no longer is an effort to explore what-if questions.

Through spreadsheets and BASIC the students acquire knowledge and experience in modelling. They come to realise that modelling is a combination of science and skill. The result is that when the topic of models and the process of modelling are tackled in a more formal way, they have a firm framework of reference and can make sense of the methodologies and concepts presented.

5. The role of the micro-computer in QMM302-V

The title of this paper is "Applied Linear Programming". The objective of the paper is to provide the student with sufficient theoretical knowledge and sufficient practical experience to enable him to use linear programming with confidence in practice.

A linear programming package is used extensively throughout the course. The package, called ESEL, was developed in the department. It is fairly sophisticated in what it can do, although it is not very user-friendly. However, the latter poses no problem as the package is written in BASIC with which the students are familiar. In fact, they find it very easy to use. The package has been implemented on various makes of computers and is obtained by students from the department at a small fee which covers the cost of diskettes and postage.

A linear model is a model in which all relationships are linear, which is the case if the relations are divisible and additive. The relationship between the number of units manufactured and the variable cost to manufacture those units are linear, since the total variable cost is directly proportional to the total number of units produced. If three products (P1, P2 and P3) are manufactured, the total variable production cost is the sum of the variable costs of the three products. This is an additive relationship.

A simple example of a linear model is:

Maximise Profit = 10 P1 + 13 P2 + 15 P3

with

$$2\ P1 + 1\ P2 + 3\ P3 \leq 100 \quad \text{(MATERIAL 1)}$$

$$6\ P1 + 8\ P2 + 5\ P3 \leq 200 \quad \text{(MATERIAL 2)}$$

and

$$P1,\quad P2,\quad P3 \geq 0.$$

This model represents the problem of having to determine the number of units of each of three products to produce so as to maximise the expected profit. The expected per unit contribution to profit for the three products are R10, R13 and R15 respectively.

The quantities that can be produced are restricted by the availability of two types of material. To make one unit of product P1, requires 2 units of material 1 and 6 units of material 2. One unit of P2 requires 1 unit of material 1 and 8 units of material 2; and one unit of P3 requires 3 units of material 1 and 5 units of material 2. 100 units of material 1 and 200 units of material 2 are available.

Any solution which satisfies the two material constraints can only be practical or feasible if it requires positive or zero quantities of the products to be manufactured.

When ESEL "solves" a problem like this it produces a listing showing the optimal product mix, the quantities of the two materials used for production, the worth in terms of profit of an additional unit of each material and a wealth of other information.

The above is a very simple example with only three variables and two constraints and can be solved by hand. However, it is doubtful whether a company manufacturing only three products using two materials would resort to linear programming to solve their "problem". Therefore the problems that are presented in this course and for which the students have to develop models are much more complex and involve many more variables and constraints. To solve these by hand is impractical if not impossible.

Now, modelling is an interactive process, which can be set out as in figure 2 below.

From the figure it is clear that the validity of a model can only be ascertained after it has been solved. And here ESEL is a tremendous help. Without it a student will construct a model, say for an assignment, send it in to be marked, wait three weeks or more for his marked assignment to get back to him and if marked wrong he may still not trust the lecturer's judgement and wonder whether his model wasn't correct. Without ESEL he will never know and after the long time lag he may even no longer be interested. In fact the value of the whole exercise may be neglible as the student never proceeds beyond the second modelling phase. With ESEL he is able to evaluate his model immediately and can repeat the cycle if necessary. Furthermore, if he is uncertain about any aspect of the model he can explore different alternatives without too much effort.

Also, having obtained a supposedly valid solution, the student uses the information printed by ESEL to draw conclusions which are relevant during the implementation phase. Thus the student gets a taste of all the modelling phases and of the repetitive nature of the process.

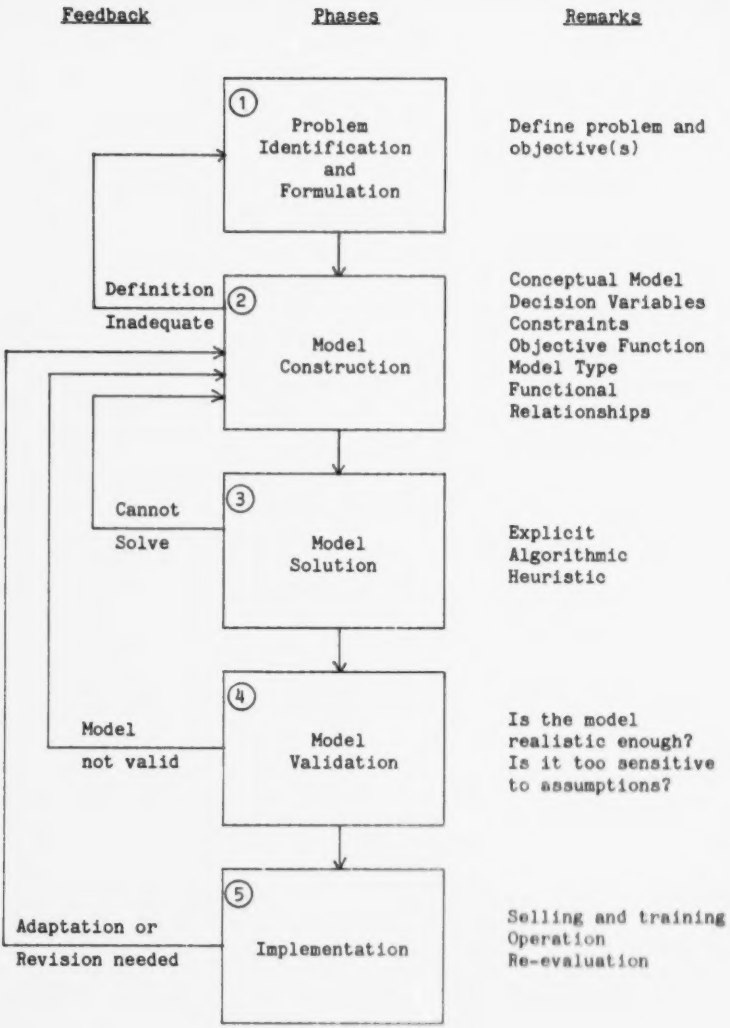

Figure 2 - The Modelling Process

When the theoretical part of the paper is covered, ESEL is used to "prove" theoretical conclusions. Also, the student can use ESEL to check out his attempts at exercises and assignments, thereby getting immediate feedback by having to find and correct his own mistakes without the intervention or advice of a lecturer.

6. The role of the micro-computer in OMM303-W

The title of this paper is "The Design of Optimising Algorithms". A wide range of optimising algorithms are presented to the student in such a way that he gains insight into the processes that preceded and accompanied the development of the algorithms.

Many of these algorithms are programmed by the student who then, by playing around with the programs, experiences that an algorithm doesn't always solve all problems, that it can solve some problems more efficiently than others etc. Not only does the student learn by using the program, but the writing of the program itself is a learning experience. A comment from many of the students who had to program a certain algorithm for an assignment, was that they thought that they understood the specific algorithm until they had to program it. The reason is that the use of the algorithm is highly dependent on the context in which it is used. If the student can follow the mechanics of the algorithm, but does not grasp how it relates to another embracing algorithm he just cannot program it.

Therefore, programming an algorithm forces the student to really get behind the logic of an algorithm and to establish exactly how and when it can be used.

In this course, the computer once again serves as an instrument of immediate feedback. A student can experiment with his own algorithms and a critical evaluation of his results will tell him if he is on the right track or not.

7. Evaluation of the program

The QMN300-T course as a whole covers a large volume of work and requires the student to master a major technological tool, the computer. For most students this is their first hands-on experience with a computer and to learn to use it effectively requires much time and effort. Furthermore, because of the nature of the course, it is very difficult, if not impossible, to catch up if one falls behind. The course content cannot be mastered by "crashing" it into a few weeks, but requires constant and sustained effort from the student.

To evaluate the students' view of the course, a questionnaire was sent out to all students who registered for QMN300-T in 1986. 28% responded.

Most of the students who completed the course successfully attribute their success to perseverance and hard work. The general opinion is that the course is tough, but well worth it. A general critisism is that the volume of the course is too large. A lack of time and difficulties with their computers appear to be the major reasons why students failed to complete the course.

Most students indicate that they are already using or intend to use what they have learnt at work, especially worksheets, BASIC programming and linear programming. Others are not in a position where they can apply it. One student remarks that although he can not directly apply his knowledge in his work, it finds many indirect applications everywhere in his life. The optimising and logical way of thinking has a decisive influence in his work.

Just to show that the academic content is not neglected, a few students complain that the course is too theoretical.

To summarise, the reaction from students who persevered and completed the course, is very positive. They find the course content useful and are proud of their achievement. Even students who have failed haven't lost their enthusiasm for the subject and are determined to pass the course at their second attempt.

8. Conclusion

Micro-computers were successfully introduced as a teaching aid in Quantitative Management III. The most important benefits of using the micro-computer are the following:

(a) It provides the student with a tool which he can use for exploring and innovating. He gets immediate and unbiased feedback from his attempts at solving problems. The student learns by experience. Also the student becomes "involved" in the course work to a degree which is impossible to attain in a more passive "reading" approach.

(b) The emphasis can be placed on teaching modelling skills. The size and nature of problems tackled are not restricted by the amount of arithmetic computations required. Therefore problems presented are more life-like and better prepare the student for what awaits him in practice.

(c) The student is cured from computer-shock. He can enter practice able to use the tool that made Quantitative Management, Operations Research or whatever you wish to call it, the useful subject that it is today.

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THE APPLICATION OF COMPUTER TECHNOLOGY IN OFFERING EQUAL EDUCATION OPPORTUNITIES TO STUDENTS FROM FIRST- AND THIRD-WORLD ENVIRONMENTS

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1. INTRODUCTION

A primary objective of any university should be to provide its students with a high standard of education, equipping them adequately for their careers. In order to attain this objective, higher education is traditionally characterised by a face-to-face tuiton system, where an expert lectures, students listen, read assignments and take part in discussion groups. Distance education originated to provide equity for students who are isolated from the traditional on-campus settings by geography or physical handicap (Lange 1986:49). This limitation should, however, not compromise quality, and a primary objective of Unisa is consequently to provide its student body with a standard of education that is of a higher or at least equal standing to that of residential universities. The role of technology in the attainment of this objective will be considered in this paper. Years of research has shown that technologically-delivered distance education is as good or better in terms of results attained (Lange 1986:61). In particular certain aspects pertaining to the application of technology in the tuition of management at Unisa will be considered.

2. STATEMENT OF THE PROBLEM

Traditionally, one of the main elements of distance education is that most of the communication with students is through the written word (Keegan in Store & Armstrong 1981:141). Communication is probably also the major area where technology can be applied in order to increase the standard of education. The application of technology in the distance education environment invariably dictates that the individual student

must have ready access to technological equipment in order to receive the message communicated by the teacher, for example a VCR and a television screen if a video tape is used.

A distinguishing characteristic of a university such as Unisa is that its student body does not primarily consist of a homogenous group of people, but originates from a number of different groups from diverse environments. It is the duty of Unisa to, amidst these complicating factors, provide equal education opportunities to all its students. Unisa is attended by students from first- as well as third-world environments. This results in the use of advanced technology unfairly depriving the third-world student of the benefits it bestows upon his first-world counterpart. The following media survey conducted among Unisa students in 1984 illustrates the situation:

Table 1
SUMMARY OF RESULTS OF 1984 MEDIA SURVEY

GRAND TOTAL: 23 997 STUDENTS

	Yes	No	Unknown
Electricity in home	85,4%	8,8%	5,8%

	Own/Have Access	No Access	Unknown
Telephone	92,0%	6,3%	1,7%
Cassette tape recorder	93,1%	5,1%	1,8%
Betamax	33,7%	52,4%	13,9%
VHS	37,9%	49,3%	12,8%
Microcomputer (Disc)	12,8%	71,5%	15,7%

Source: Buro for Teaching Development, Unisa

The severity and nature of the problem is illustrated by the fact that while 12,8% of the students either own or have easy access to a microcomputer with disc storage, 8,8% do not even have electricity in their homes. The survey also shows that approximately half of the students do not have ready access to video equipment.

In the light of the above it is obvious that students cannot be expected to create a high technology environment in order to pursue their studies through Unisa, as this will result in Unisa becoming inaccessible to a large proportion of its current student body. Study material, therefore, cannot be provided on high technology media such as floppy disc or video cassette, as this will result in an unfair benefit being given to the more privileged first-world student. To avoid this Unisa will have to create a high technology environment for its students in order to enable all of them to reap the full benefit of high technology. This is not a viable alternative however, as the cost of such a project will be prohibitive. A conservative figure of R2000 per student, which is the minimum outlay to provide students with microcomputers in their own homes, will amount to an initial expenditure of approximately R180m for the current student body.

Unisa must therefore continue communicating with its students by means of the written word as its primary method of communication. The objective of this paper is to, within the boundaries of this limitation, propose a method regarding the application of high technology to increase the efficiency and the standard of Unisa's education.

A problem, that is especially applicable to a dynamic subject such as business management, is that course material should ideally be adapted and updated on an annual basis or optimally even more frequently. Because of the time consuming process of producing tutorial matter currently, courses are presently revised at three yearly intervals, and it takes the best part of a year after completion of a study guide before it is ready for distribution. A consequence of this is that tutorial matter is often outdated even before it reaches a student, which is detrimental to the standard of education.

3. OBJECTIVES

The primary objective of this paper is to propose a tuiton method which, by the application of computer technology, may lead to a higher standard of education in management within Unisa.

4. A HIGH TECHNOLOGY APPROACH

4.1 Introduction

The approach suggested is for Unisa to make use of high technology internally to overcome the stated obstacles without requiring any additional expense by its students.

4.2 A proposed solution

A possible solution to the stated problem is by implementing a fully integrated computer network throughout the university. Every university employee who at some or other point handles tutorial matter should have a computer terminal on his or her desk. All tutorial matter used throughout the university should be stored and maintained on the central computer. The concept of the proposed system is best explained by means of the following example.

Professor X learns from research about new management techniques and decides to introduce the concepts into an existing course. The existing study guide is stored on the computer system. When he requests the system to make the guide available for amendments through the computer terminal on his desk, a temporary amendment copy of the guide is automatically made on disc storage. The system at this point, enquires whether the anticipated changes are to be implemented for the current year or only from the next academic year. A tag is also placed on the specific guide so that nobody else, other than Prof. X, is allowed to access this guide in amendment mode until the amendments have been finalised. Prof. X amends the guide with the aid of a word processing package that is available on the system. Once he has completed the task he notifies the system that he has completed his amendments. The system automatically transmits a message to the editorial

department where it notifies them that the guide has been amended and that they should commence with their editing. The system highlights all the areas that Prof. X has changed and they consequently do not have to edit the whole text again. Once completed the system notifies Prof. X that his amendments have been edited and he is in turn supplied with all the editorial changes, which he immediately checks. The system then notifies the translators of the changes and supplies them with the translation of the guide in amendment mode. They implement the amendments on the translation, the system sends it to Prof. X for evaluation, then to editing and finally back to Prof. X. He notifies the system that all amendments have been finalised and the revised pages are printed and mailed to all students registered for this particular course, providing that the amendments are to be implemented in the current year. The study guides provided to the students are not bound, but are supplied in ring binders so that amendments during the year can easily be implemented. The study guides are furthermore not printed and stocked, but printed on a bank of laser printers when required, for example with the registration of a student.

It is clear from the example that an objective of the system is to eliminate paperwork and to reduce the repetition of work, such as the repeated editing and proofreading of the same work, as is presently the case. The proposed system should have the following essential characteristics:

- A major function of the computer system should be to keep track of and control changes to existing tutorial matter, the implementation of new tutorial matter and the passing on from one point (eg the lecturer) to another (eg the editorial department).
- Study guides are not bound but supplied in ring binders - which facilitates amendments throughout the year and eliminates the need for binding equipment.
- All academic staff as well as administrative personnel who work with tutorial matter must be supplied with a computer terminal on their desks.

- All tutorial matter is kept on disc storage on the central computer.
- Tutorial matter is printed on a bank of laser printers at the time of student registration or when it must be mailed to students.
- The system should incorporate a diary for academic staff as well as an electronic internal mailing system, eg between departments and colleagues.
- The system should group tutorial matter of different courses for a particular student to reduce mailing costs.

4.2 Prerequisites

There are basically two prerequisites for this system, both of which involve a substantial outlay of capital. These are:

- The computer system employed by the university should be extended to handle the proposed network as well as the vast amount of tutorial matter. A well designed coordination and controlling system should be incorporated as well.
- It will be an absolute prerequisite that all users of the system posess a high level of computer proficiency as the system will become an integral part of the daily activities of the personnel.

A factor that should not be overlooked is that academic staff should be able to type at least as well as they write with a pen or pencil. Neglect in this area will undoubtedly lead to a loss in productivity.

4.3 Anticipated advantages

The advantages of the proposed system are legion, and only a few of the most remarkable advantages will be discussed here. These are:

- It eliminates duplication of work, especially in the composition and revision of tutorial matter, which contributes to an increased level of productivity by academic staff. This, in turn will alleviate the problem of a shortage of qualified business faculty, which is a problem in most developing countries (Flores 1983:56).

- Changes to tutorial matter can be implemented with ease as well as being timeous and quick. This will invariably increase the standard of education, especially for courses in such dynamic areas of study as management.
- The grouping of tutorial matter of different papers will enable considerable savings in mailing costs.
- No physical space is required for the storage of tutorial matter and there is consequently no redundancy of printed study guides.
- Physical reproduction of internal notices may be eliminated as a result of the use of electronic mail which will contribute to a considerable saving in paperwork.

4.5 Points of caution

It is appropriate at this point to warn against over reliance on the computer system. There are certain points where human control must be exercised, especially with regard to the authorisation and monitoring of amendments to study material, as frequent unjustified changes would lead to chaos.

Research by Lange (1986:61) indicates that the implementation of educational technology is usually met with opposition and a great deal of resistance to change. Care should be exercised to involve and inform all academic staff before commencing with such a system.

5. CONCLUSION

The tuition method proposed is not a tested or researched suggestion. It is stated in the form of a proposition which would require further research and a more detailed description before its viability could be assessed. It is, however evident that the existing tuition method leaves room for much improvement and that the application of high technology should be closely investigated as an alternative solution to the continuing pursuit of academic excellence.

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THE LAW STUDENT AND THE LAW LIBRARY

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INTRODUCTION

Research in the United Kingdom and the United States has shown that recent law school graduates have difficulty in using a law library, particularly for research purposes.[1] In South Africa the situation is perceived to be very similar, especially in view of the fact that law libraries, until very recently, were merely collections of legal materials not geared to cope with or rectify many of the problems associated with legal research.

Where, therefore, in a distance education situation students are often not able to make use of law library facilities, nor (and more importantly) are they shown how to use legal sources and materials we should question whether, upon graduating, they are properly equipped to do any effective legal research.

UBI LIBRI IBI SCIENTIA[2]

Already in 1873, Christopher C Langdell, who had the honour of being Dean of the Law School during the so-called 'Golden Age' of Harvard Philosophy[3] had the following to say:

> "The Library is to us what the laboratory is to the chemist or the physicist, and what a museum is to the naturalist".[4]

In the more than 100 years following on this statement, this point has been stressed again and again, in a variety of nuances but essentially containing the idea that the law student who does not make full use of the law library may well get through his examinations, but is missing an important part of his education.[5] Characteristic of the weak student is that the "will withdraw, taking comfort in his lecture notes and the textbook or some condensed version thereof",[6] never realizing that the library should actually be his "new home for the rest of (his) professional life".[7]

In whichever branch of the profession, be it the attorneys,[8] advocates, legal advisors or researchers[9] the principle is the same - the power of the written word is centripetal.[10]

INFORMATION RETRIEVAL

More than in any other discipline, the lawyer is dependent on information, particularly printed information because, unlike other professions law combines a high rate of output of new information with the need to preserve and accumulate it for an indefinite period of time.[11]

Authority on a topic may be found in a case or in a statute dating back perhaps 100 years[12] or possibly a few weeks. All information should therefore be at the lawyer's disposal. Where, however, the problem arises is in the retrieval of that information.

The excessive growth in the amount of legal literature, both by volume[13] and variety[14] has resulted in the development of so-called 'finding tools' which act as a bridge between the researcher and the information. Not only do these tools include straightforward bibliographies and indexes, but more often they are sophisticated indexing, retrieval and verification systems which require instruction both in the use of the tools themselves and in choosing among them.[15] Particularly the use of computers and microform systems, traditionally developed in the United States,[16] but at present finding increasing application in South Africa[17] requires a high degree of skill.

The more accessible all this material becomes, the more competitive will research demands be, and in order to keep up with the opposition, obscure reports and other data will have to be consulted.

Should one therefore wish to know anything about law reporting, legal terminology, journals, annotations, abbreviations, use of reference tools, etc., an intimate knowledge, particularly of how to trace and locate relevant information within the law library system is essential.[18]

An efficient system of legal information retrieval is therefore necessary to carry out effective research. Only after the information has been traced is the necessity for study created.

We should differentiate between these two,[19] since for study purposes little library initiation or orientation is necessary, while for research purposes this is essential. For study purposes, our students are very well catered for.[20] However, the crucial question is whether our graduates have learned to do research, which is an essential characteristic of any legal professional activity, and upon which we concentrate here.

LEGAL RESEARCH INSTRUCTION - THE STATE OF THE ART

In the late 19th century when law schools worldwide were young no training in the techniques of legal research was provided anywhere - this is hardly surprising as legal research was the domain of only a handful of scholars.[21]

With the advent of the case method of law teaching in the United States early this century the need for legal research instruction became apparent.[22] Lawyers' bibliographic skills became dependent upon either their own initiative in learning how to use law libraries or upon instruction from their teachers or law librarians.[23]

By the mid 1920's nearly half the law schools accredited by the Association of American Law Schools were offering instruction in legal bibliography. Today most law schools have research instruction programmes,[24] which are usually presented in the first year of study. The primary objective of these programmes is generally the teaching of bibliography and research methods, as well as the improvement in the style of writing.[25]

In the United Kingdom research[26] has shown that approximately 70% of legal teaching institutions provide instruction in legal research method and the use of law books. The courses consist of discussions on the nature of legal publications, authoritative sources, primary and secondary sources, the

necessity of citations and currency in law books. These courses are also usually presented in the first year of study.

South African law faculties offer little comparable instruction. An exception is the University of Natal which offers a course in Legal Method to LLB students. This course comprises: Introduction to Legal Technique; Case Law; Authorities; Statute Law and Legal Writing - very similar in content to the overseas courses described.

In most other cases one has to look to the law libraries[27] for instruction in legal bibliography and research methods. Concerning South African libraries, regardless of their type and nature, user education is generally a neglected field.[28] That education is being given is certain,[29] but very little[30] has been published, particularly on the trends and techniques applied - information crucial to the profession as a whole.

Regarding specifically the university law libraries in South Africa no published information exists as to the position concerning user guidance. It does exist, but limited in a number of aspects: - the law library profession in South Africa is a young one.[31] Law librarians receive no or very little training in Law and the use of legal materials.[32] Their expertise is derived mainly from experience and not more than a handful of law librarians have been around long enough to provide such a sophisticated service. Where the law faculties do not demand specialized legal research techniques, law libraries are not made aware of any need. Where it does exist, it is purely on the initiative of the librarian.

The scope of orientation or guidance techniques is limited usually consisting only in visits to the library where students are shown around. The most important case materials are introduced and discussed and an indication given of which finding tools are available.

LAW LIBRARY PROBLEMS OF A DISTANCE EDUCATION STUDENT

Were all law students to receive even these basic guidelines, whether it be in their own university law libraries or in the myriad other law libraries around the country they would only gain. The point is, however, that very

few law students receive any library instruction. Perhaps this puts all students, distance education or not on a par. What, however, puts the distance education student at a disadvantage is that he carries the additional burdens of Time[33] (insufficient to really browse around a library) and Distance (frequently far from a law library).

The opening sentence of this paper stresses the point that Law School graduates, interpreted as having been full-time residential university students, cannot use a law library.

In an article dealing exclusively with the problems of part-time students the author[34] states "that part-time law students make far too little use of the library, relying excessively on limited textbooks and casebooks. These students need to be more aware of the library, encouraged more to use it."

If the full-time student's reputation regarding his library use is not good, and the part-time student's reputation is bad, what then of the distance education student who can often not even get to a library, let alone receive instruction in its use?

LEGAL RESEARCH INSTRUCTION - METHODS

We should examine both present techniques and future possibilities in order to determine how training in legal research can be made viable for only by being trained in legal research is proper legal professional competence possible.

INTRODUCTORY COURSES

Introductory courses are at the order of the day in many overseas countries.[35] Most effective are those where the course forms part of the legal curriculum presented by the legal teaching staff.

Where introductory courses are presented by the library, the form taken is that of introducing the user right at the beginning, to the essentials of law reporting, legal terminology, textbooks, practitioners' books and journals.[36] Furthermore he should be told what the abbreviations mean and

how to use the reference tools, a task which the librarian or lecturer should perform in a formal lecture of an hour or two. Research[37] done by the Open University indicates the preference given to courses, the most helpful sources of guidance being course study guides, other written course material and course lectures. Other methods found to be helpful were special radio and television programmes associated with the course.[38]

The Unisa Library[39] has recently initiated the presentation of formal introductory lectures on the use of the library.[40] The procedure followed here is similar to that recommended by a variety of authors[41] who stress that liaison[42] between the academic and library staff in presenting such courses is desirable.[43]

PUBLISHED INTRODUCTIONS

In order to assist students in their use of the law library it is practice both in the United Kingdom[44] and the United States[45] for law students to purchase published introductions to legal research. Examples of these are Dane and Thomas' How to Use a Law Library,[46] Berch's Introduction to Legal Method,[47] Cohen's How to Find the Law,[48] Jacobstein's Fundamentals of Legal Research,[49] Deaver's Complete Law School Companion,[50] and many more. The method usually applied is to introduce the reader to the different legal materials and to explain their use. Furthermore bibliographic sources and retrieval systems are explained in considerable detail. These publications are very valuable indeed, and greatly assist all students, although they have spatial limitations as to the amount and type of information which can be included.[51] Unfortunately this country has nothing similar to offer.

READERS

The reading of all legal materials, but especially court decisions is essential in the study of law. Where Unisa students are unable to make use of law library facilities, they can obtain from the University what is known as a Casebook[52] containing all the court decisions relevant to the study of a particular subject. Similarly journal articles are made available. This service assists students therein that they have no need to obtain this material from the library, either by request or by themselves. It was

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mentioned earlier on that the preliminary step to study was research. By providing such ready-made information, that preliminary step is ignored. The student is therefore not placed in a position where he himself is responsible for finding the material. This is a disadvantage, particularly for his future research capabilities since he will have difficulty in learning to use Noters Up and he will not easily understand the meaning and value of Annotations to Law Reports.

SPECIFIC GUIDANCE METHODS

A problem associated with court decisions, not only in South Africa, but also elsewhere[53] is that students, particularly the more junior students have difficulty in reading or studying them. We have found[54] that confusion exists as to the different parts of a court report and the function of each, e.g. the headnote, the facts, the legal argument, the ratio decidendi, the decision, and minority and majority decisions. To remedy this, assignments are set concentrating on these aspects. Also, in the examination stress is placed on particularly the study of cases. A project in preparation at present[55] is the compilation of an audio cassette, which together with the printed version of a decision enables the student to understand and analyse it. Furthermore the techniques of reading court decisions as well as introductions to the use of the library are presented by lecturing staff as an integral part of introductory group discussions.[56]

At Unisa communication with students takes place by way of tutorial letters. The purpose of these is varied. However, included in their purpose is to inform students of which literature should be consulted. This approach is applicable to all levels of study, including the Master's degree courses where detailed bibliographic information is provided. Even at this level, the student need only approach the library and he will be given a 'package' of all the material he will require for his studies. Although this is a good service which is provided by the library indicating its awareness of the particular problems of distance education students,[57] the student is indirectly hampered since no obligation is placed on him to find the material himself. He therefore never really learns the research technique, which may well hamper his future profesisonal abilities.

Besides these techniques and services the library provides other methods whereby the burden is lightened for the distance education law student, viz: A service exists whereby the law librarian will provide the post-graduate student with a bibliography of relevant literature on a particular topic. Also, a special collection of legal textbooks is kept separately for reference purposes. For convenience and accessibility these works are not issued on loan.[58]

Opening hours are important to the distance education student.[59] Despite possible staffing problems the law library maintains similar opening hours to the main campus library.

FURTHER POSSIBLE RESEARCH INSTRUCTION METHODS

It is an established fact that the best method of learning is in a one-to-one situation where student-teacher interaction is optimal.[60] A similar method (already discussed supra) is being used in the Unisa Library, but should be extended to include particularly law students, law library staff and law teachers.

If we recall Langdell's statement that the library is to the lawyer what the laboratory is to the chemist or physicist we immediately see the necessity of some 'in-house' or 'hands-on' experience. Just as chemistry students undertake practical laboratory work, should not the law student be expected to gain practical library experience, possibly even as part of an introductory legal course.

The introduction of audio-visual materials as aids to instruction should also be considered. This medium is not accepted unconditionally since it is felt that it dehumanises the learning process, it is expensive and it is not interactive.[61] If applied in a library situation it would be necessary to integrate this medium with actual use of library material.

Computer-aided-instruction, important in that two-way interaction with the user is possible, has been applied in libraries, particularly in the United States.[62] Here two firms are now producing commercially available software for libraries.[63] The development of good user-education programmes is an

exciting challenge to librarians of the future. By possibly linking computer-aided-instruction with video, the realm of three-dimensional instruction is reached, whereby the student can relate to what has been learned and is also given the opportunity to ask questions.[64]

CONCLUSION

The quality of our legal profession is dependent upon the quality of our legal education, part and parcel of which should be library instruction in bibliographic and research methods to law students.

A joint effort is required by law and library staff alike to build upon the foundation already laid - one of understanding and assistance. Now, more dynamic, user-orientated methods are required. Perhaps a start can be made with the introduction of a course similar to that presented at the University of Natal, or an extension of Unisa's Library Orientation Course to the Law Library - maybe even a printed publication, or perhaps a video, and, as a dream for the future - computer-aided-instruction.

FOOTNOTES

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2 "Where there are books there is knowledge".

3 Stevens, R Law School; Legal Education in America from the 1850's to the 1980's. North Carolina Press 1983. See also Thomas, D "The American Law School and its Library: A Unique Relationship" 1985 Law Librarian 77.

4 Danner, R "Reference Theory and the future of legal reference service" 1983 Law Library Journal 217 note 29.

5 Marett, D "The Law Library and the Part-time Student" 1982 Law Librarian 27 at 28.

6 Kenny, P Studying Law Butterworths 1985 at 41.

7 Deaver, J The Complete Law School Companion Wiley 1984 at 32.

8 See particularly in this regard the contribution by Axelroth, fn 1 supra.

9 See more specifically Delport, JT "Die toeganklikheid van Regsinligting: Die Regsgeleerde se Dilemma?" In: 11th South African Law Conference, Papers. Port Elizabeth 23-26 April 1984 at 89.

10 Mersky, R "Everything you always wanted to know about Law Libraries but were afraid to ask" 1978 Journal of Legal Education 139.

11 Tapper, C "World Cooperation in the Mechanisation of Legal Information Retrieval" 1968 Jurimetrics Journal 1 at 2.

12 as the recent 're-discovery' of the 1896 South African Republic Sunday Observance Act no 28 demonstrates. See Pretoria News of 17 February 1987.

13 On average one new legal journal title appears annually in South Africa.

14 E.g. the legislation pertaining to the Independent and National Southern African States. See Loynes, P "Black State Law: the Librarian's problem" 1981 TSAR 150.

15 Danner at 221.

16 E.g. LEXIS and WESTLAW. See further Danner at 228; Mills at 347-348.

17 E.g. by Jutalex, a legal information service on Beltel. See also Van der Merwe, DP Computers and Law Juta 1986 who, although referring to the retrieval question, concentrates only upon the effects of the use of computers in society, and the need for legal regulation of that use.

18 Marett at 27-28.

19 See Kenny at 131-133. An informal questionnaire completed by a small number of Unisa law students indicated that the questions which were research-orientated could not be answered. While those who were study-orientated were answered correctly.

20 See infra.

21 Mills at 343.

22 Foote, M "Need for College Instruction in the Use of Law Books" 1917 Law Library Journal 25.

23 Sadow, S and B Beede "Library Instruction in American Law Schools" 1975 Law Library Journal 27.

24 Sadow at 27; Mills at 346-347.

25 Rombauer, M "First-year Legal Research and Writing: Then and Now" 1973 Journal of Legal Education 538, at 550; Carlson R "Innovations in Legal Bibliography Instruction" 1981 Law Library Journal 615.

26 Bull at 252-261.

27 Only the larger university libraries have subject specialist law libraries. This situation differs from the United States where the Law Librarian is often a faculty member with academic status.

28 Laburn, C "User guidance and training" 1984 South African Journal of Library and Information Science 94 at 97.

29 E.g. the Library Orientation Programme at Unisa, implemented in 1986.

30 But see the recent article by Williams S "User Education in the Unisa Library" 1986(2) Progressio 6. The Law Library has unfortunately been excluded from this programme.

31 A body, the Organisation of Law Librarians (OSALL) representing mainly practitioners' libraries was instituted in 1976 to bring about more cooperation between law libraries. University law librarians are not well represented.

32 Only OSALL provides training courses in the use of law library retrieval materials.

33 Wilson, TD "Learning at a Distance and Library Use: Open University Students and Librarians" 1978 Libri 270 at 276; Marett at 27.

34 Marett at 27-28.

35 See references at fn 1 supra.

36 Laburn at 95.

37 Pearce, B "Tuition in Library Use as a part of Open University Preparatory Courses" 1976 Library Review 254; Wilson at 277.

38 Wilson at 277.

39 not the law library unfortunately.

40 See: How to use the Library: a Library Orientation Workbook for first year students Unisa 1986; see also Williams at 6.

41 See e.g. Marett at 28; Thomas at 79-80; Mersky at 145.

42 This liaison should not end here, but cover all common ground. See Liivak, A "Academic Law Librarians in the United States of America. Lawyers or Librarians?" 1975 International Journal of Law Libraries 162.

43 In this regard the Library Guide for Lecturers, published by the Department of Library Services of Unisa (1987) is relevant.

44 Marett at 27.

45 Carlson at 616.

46 Dane, J How to Use a Law Library Sweet & Maxwell 1979.

47 Berch, MA Introduction to Legal Method and Process West 1985.

48 Cohen, ML How to Find the Law West 8 ed 1983.

49 Jacobstein, JM Fundamentals of Legal Research Foundation Press 2ed 1981.

50 See fn 7 supra.

51 Laburn at 95.

52 Also discussed by the Dean of the Unisa Law Faculty no 3501 in Conference Book of Abstracts.

53 Mills at 343.

54 especially in Private Law I and II.

55 for Private Law I students, numbering ± 2000 this year.

56 E.g. Private Law II group discussions.

57 See further Marett at 28.

58 Bevan, N "Assisting the part-time law student" 1983 Law Librarian 10 at 12.

59 See Bevan at 10. See also Questionnaire referred to in fn 19.

60 Laburn at 95.

61 Laburn at 96.

62 E.g. the PLATO system. See also Danner at 223.

63 Laburn at 96.

64 Ibid

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THE EFFECT OF ADVANCES IN INFORMATION TECHNOLOGY ON THE TEACHING OF PRACTICAL ASPECTS OF COMPUTER SCIENCE AT UNISA

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ABSTRACT

The Department of Computer Science and Information Systems at Unisa is a relatively new department, having been established as the Department of Computer Science in 1969. In 1986 approximately 5 500 students were registered for Computer Science and Information Systems. In this paper we explain the way in which we address the problem of teaching practical aspects of Computer Science to students, many of whom we never see. Some actual practical experience in designing, writing, testing and debugging programs is an essential part of a degree course in Computer Science. We examine the effects advances in information technology have had over the years on our handling of these aspects of our subject, and how such technological progress may in future enable us to improve the situation still further. (We discuss considerations in choosing programming languages and also mention the problems we still experience in teaching the practical aspects of the curriculum.)

1. INTRODUCTION - THE DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION SYSTEMS

In 1970 a department of Computer Science was instituted at Unisa and a total of 707 undergraduate students registered for this subject. The first postgraduate students, a total of 55, registered in 1972. The number of students registered has grown at an average rate of 26% per year. In 1986 the students per module statistics were: 15 141 undergraduate and 768 postgraduate students. This involves approximately 5 500 students. The undergraduate students in our department constituted 45,5% of all undergraduates in the Faculty of Science. The department has a staff of 24 lecturers, of whom 6 are professors or associate professors, and 8 administrative assistants as well as numerous part-time staff members. At present we have vacancies for 6 lecturers.

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Prof. C. H. Bornman is a professor in the same department and has previously served as head of department.

Mrs. P. M. Fallick is a senior lecturer and Mrs. C. de Villiers is a lecturer in the department.

2. METHOD OF TUITION

As is the case throughout Unisa, the modules in Computer Science and Information Systems are taught largely by means of the written word. We have also prepared a few tape cassettes containing recorded lectures. Our department has made use of video tapes and slide programmes to show students examples of different computer facilities and to illustrate the history of computers.

Discussion classes, which can take the form of lectures or workshops, are held at the regional offices for first and second-year modules from time to time. It is found that many students travel long distances to attend these lectures. Students are also encouraged to consult their lecturers either by letter or during personal visits.

There is, however, an additional aspect to the tuition in this department. Students require practical experience in designing, writing, testing and debugging programs and in order to do this, need some way of accessing a computer. The requirement for students to master a practical component of their work is not unique to Computer Science and is handled in different ways by different departments at Unisa. We would like to discuss those elements of teaching the practical aspects of the course which are unique to computer science and also the ways in which the department of Computer Science and Information Systems at Unisa attempts to do this.

3. TEACHING PRACTICAL ASPECTS OF COMPUTER SCIENCE

3.1. General

Computer science and information systems are probably amongst the fastest-changing disciplines presented at universities. The advances made in respect of both hardware and software are so rapid and so revolutionary and are so quickly adopted generally by Computer Science practioners that we have to be extremely careful that we not only stay abreast of developments but that we also do not follow paths which will be abandoned again in the near future. According to Professor Maurer of the Technical University in Graz, Austria, half of the knowledge obtained in Computer Science becomes outdated within about six years [Maurer, p. 69]. This extraordinary rate of development also gives rise to an enormous number of different hardware and software products, some of which are similar and others of which are completely incompatible. We therefore have a major task in deciding what should be taught before we start to consider how it should be taught (which is of course yet another major task). We must be reasonably conservative and ensure that new trends are substantial before we include them in our study material but, on the other hand, we must not allow ourselves to be "left behind". We try, therefore, to ensure that we emphasise the principles underlying various skills, techniques, and even new research directions, and although we attempt to use new hardware and software products as examples, we avoid teaching the specific use of any one product.

This type of decision is reflected in the programming languages which we teach the students and the hardware on which they are expected to complete their practical work. It also affects the discussions which we include in the study material as to the entire programming environment, including tools provided to assist the programmer and techniques which are commonly used, in which modern programming occurs.

We would like to examine the way in which our choice of programming languages and computer facilities has changed over the last fifteen years in response to the changes in information technology. Thereafter we will look at certain problems which we still experience in teaching the practical aspects of Computer Science before looking to the future to see what possible advances can be expected.

3.2. Programming Languages

The policy in the Department of Computer Science and Information Systems has always been to teach basic programming principles such as sound design, structured programming and problem solving, and not to teach programming languages per se. The programming languages we have used to illustrate these principles have changed over the years in response to the languages which are available, shifts in the use of languages in the "real world" and practical considerations.

We have tried to make languages available to the students which would assist them in writing well-structured programs, and it was for this reason that we changed in 1980 from the rather rudimentary BASIC programming language to PL/I when that became available on the university's computer. At second-year level we taught students COBOL, a language which is still used extensively in commercial applications and which students are therefore keen to learn.

By 1984 we found that a number of students owned microcomputers. PL/I is not generally available on microcomputers so we decided to make a major change to our approach to teaching programming in an attempt to achieve the flexibility we required. First-year students were given a thorough grounding in basic programming and data structures using a form of pseudo-language, SPES, which was developed in conjunction with the Departments of Computer Science at the University of Pretoria and the Rand Afrikaanse Universiteit. (A pseudo-language is a language used for designing algorithms. It is not as rigid in its syntax as a programming language, but is nevertheless quite formal and un-ambiguous and reflects the required programming structures. A pseudo-language cannot be run directly on a computer, but it is a simple procedure to convert from it to most high-level programming languages.) Thereafter students were given the option of programming in a number of different languages. Schemes were provided showing the mapping from SPES to each of these languages. SPES gave us the necessary common ground whilst the choice of languages gave the students a great deal of leeway and flexibility.

We found that the introduction of choices in the programming language students could use created a number of problems for the lecturers.

- This system necessitated setting and marking assignments and examination questions in all the languages, a difficult task as the languages are not all equally suitable for completing a single task.

- Staff who were experts in the languages should ideally have been available to answer students' queries at all times, which was not always the case.

- A considerable amount of co-ordination was required to ensure that such a system worked equitably.

It is for these reasons that it was decided to allow students to use only Pascal in first-year programming as from 1987, and in second year as from 1988. Pascal was chosen as it is a high-level, block-structured, strongly typed language which is readily available for a variety of microcomputers and facilitates the application of sound structured programming concepts. It is not a particularly new language but is nevertheless one of the new generation of languages while it has the advantage of being well established and supported. This choice is in fact in line with that at a number of universities both in South Africa and overseas.

3.3 Computer Facilities

The provision of facilities for students to do practical work is always something of a problem at a distance-teaching university. Some departments require students to attend compulsory practical sessions, whilst others attempt to make arrangements with outside organizations to allow the students access to their facilities.

The Department of Computer Science and Information Systems at Unisa has had a variety of systems over the years which have been amended and improved largely as a result of better and cheaper technology becoming available.

Initially use was made of a system using the large Burroughs computer at Unisa. Students submitted programs by post, either as code written on coding sheets or on mark sense cards to be run at Unisa. These programs were then marked and commented on by the lecturer, and posted back to the student. The student then had the opportunity to code amendments to his program and the whole process was repeated. The number of marks awarded was amended as further improvements to the task were received. The major problem in these systems was the long turnaround time (particularly when the program had first to be punched), exacerbated by the length of time it took before the program was satisfactorily executed.

Students having access to outside computers have always been permitted to develop their programs independently and merely submit a final version. Over the years, more and more students have begun to use outside computers. Hence far fewer students make use of the postal systems than was originally the case. (The Fernuniversitat in Hagen does not allow its students to make use of computers in their home or work environment in the course of their studies [Schlageter, p. 24] and the Open University of Hagen is only now investigating the possibility of the use of home computers [Mulder, p. 82]. Up to now both universities have required students to do their practical work either at regional centers or during compulsory laboratory sessions at the university.)

More recently, Unisa made terminals connected to their Burroughs mainframe available at the branch offices for students to develop their programming assignments, and in 1986 microcomputer laboratories equipped with IBM microcomputers were established at the four branch offices to provide students with additional computer facilities. This advance is in line with a world-wide move away from the use of large mainframe computers, in favour of personal computers for use in education [Bork, pp. 24 and 26].

A major change in policy in this department has recently been approved by the University. Students registering for Computer Science for the first time will, as from 1987, only be admitted if they have access to a suitable computer (either their own, a friend's, employer's, or the terminals and microcomputers at the branch offices). This has been done firstly in order to ensure that students do gain some experience in working directly with a computer, and secondly to cut out the postal systems which were unsatisfactory because they were so time-consuming. It is generally expected that the number of home computers bought simply so that their owners can learn how to use a personal computer, will escalate. It is estimated that there will be between 50 and 80 million such computers in homes before the end of the 1980s [Pressman, p. 198]. Although these will generally be in the United States, we are finding that many South African families already own their own PCs.

3.4. Examination admission

Students are required to write a number of programming tasks of varying degrees of difficulty, in addition to written assignments during the year. The marks awarded for programming tasks and written assignments are used to determine whether or not the student should be admitted to the end-of-year examination. It is not possible to obtain sufficient examination admission credits without completing some of the programming tasks satisfactorily. It is also not possible to pass either first or second-year Computer Science without passing the practical programming modules. We can, therefore, be reasonably sure that our Computer Science graduates have completed a certain amount of programming and achieved a satisfactory, although limited, proficiency in this practical aspect of Computer Science education.

4. PROBLEMS EXPERIENCED BY THE LECTURERS

4.1 Marking

Lecturers find that the practical component of the students' work creates an enormous volume of work for the staff. Almost all assistance with practical work has to be given in writing to the student and is usually given individually. As the student numbers are so large, this necessitates a team of lecturing assistants. We envisage having three or four lecturers and an equal number of markers who work on a part-time basis from home, involved with the first-year programming modules. Care has to be taken in administering the work of such a team to ensure that efforts are co-ordinated and an even standard is maintained.

4.2 Variety of computers

The fact that our students are permitted to submit programs developed on a wide variety of computers adds to the lecturers' problems. Not only do these programs have to be marked, but the lecturer is also expected to be able to answer questions concerning the operation of a wide variety of computers and compilers. This becomes very difficult when students are programming in assembly code, since there are significant differences between the various processors and assembly languages used by the students, and students frequently require detailed replies to their queries. Fortunately we are finding that, these days, there is a tendency to buy "industry standard" computers on which the more popular software will run, as the price of these machines comes down.

4.3 Examination of practical aspects of Computer Sciences

Another major problem recognised by the lecturers is the setting of a fair examination that tests the knowledge and problem-solving ability of the students. It has been found over the years that it is impractical to ask students to code programs in examinations, particularly since they write a single two-hour paper for each module. (This is being extended to three hours for the first time in the October/November examination of 1987.) We cannot incorporate the marks obtained for programming during the year in the final results as we have no proof as to whether the programming was actually done by the student himself. The final evaluation of students' practical programming ability is, therefore, difficult. The Departments of Chemistry and Physics at Unisa have compulsory practical examinations held under formal examination conditions in their laboratories. The number of students involved in Computer Science make this quite impossible as we would have to obtain access to over 800 computers even if we only call upon those students who pass the theoretical paper to complete a practical examination. In addition, we would presumably have to provide students with a computer of the type on which they had done their assignments during the year!

At present, the approach in second year is to include a single program repeated in each of the programming languages and ask questions about it, hence testing the student's ability to read a program. We also ask the students to design, but not to code, a simple program to determine their ability in this regard. In addition, essay-type questions on theoretical aspects of programming are asked on, for example, testing, documentation techniques, et cetera.

4.4 The high drop-out rate

There is a very high drop-out rate, particularly amongst our first-year Computer Science students. We would like to make a thorough investigation into the reasons for this at some stage. We can, however, surmise why students drop out at the rate they do. Possibly the combined burden of a career and demanding studies is too much for some of them. It is also possible that some students take Computer Science for the wrong reasons. Some may be attracted to Computer Science by the highly paid jobs reputedly available in this field, whilst others are aware that this is an important and expanding area and that they should equip themselves for the future, but do not really need a degree course in Computer Science to

fulfil their requirements. A short computer literacy or programming course would suffice. Unfortunately, many of the students are either not really interested in the subject itself or else are not capable intellectually of mastering it and hence quickly fall by the wayside.

5. PROBLEMS EXPERIENCED BY OUR STUDENTS

5.1 Difficulty in gaining access to a computer

It seems that this is not as severe a problem as we imagined. We thought that there would probably inevitably be cases in which the requirement that students have access to computers would create an insuperable problem and we forecast a drop in our student numbers as a result of this. In fact our student numbers for 1987, the first year in which this rule applied, have not decreased dramatically at all. There were 2693 students registered for the first-year practical programming module this year, compared with 2790 in 1986. One should note that the requirement that students have access to a computer was not the only change in admission requirements. There was simultaneously an alteration made in the mathematics required and this would also have reduced the numbers of students accepted.

5.2 Isolation

The problems of isolation and the accompanying frustration are probably intensified in Computer Science by students' initial nervousness of the computer and the fact that a small problem may result in an inability to progress at all. We have had reports of students sitting in front of a microcomputer in the microcomputer laboratory for an hour without even getting started and eventually leaving, never to return. Unisa does help students to make contact with other students taking the same courses who live in the same area, in the hope that the students will be able to form study groups and help and encourage each other. We hope that by insisting that students have direct access to a computer or terminal we will be able to ensure that, by the time they graduate, our students have overcome any such fears they might have had.

6. HOW MUCH PRACTICAL WORK IS IN FACT NECESSARY AS PART OF A DEGREE COURSE IN COMPUTER SCIENCE?

It has been suggested that far too much emphasis is placed on programming in our Computer Science course. Firstly, as a distance-teaching university we are not really in a position to be practically oriented and might thus be better advised to concentrate on the more theoretical aspects of Computer Science. Secondly, it is believed by many that Computer Science is an abstract science and that it is not really necessary to ensure that students have mastered the practical skills associated with it. Thirdly, students tend to lose sight of the most important issues in Computer Science when they write programs and tend to pay undue attention to syntax instead of program design and problem solving in more general terms. It is possible to test a student's understanding of the principles of Computer Science and his problem-solving abilities without requiring him actually to write working programs. On the other hand, by running his algorithm in the form of a

program on a computer, the student can demonstrate the correctness or inadequacies of the algorithm to himself. This re-enforces his learning enormously and gives him the opportunity to correct the work if necessary before submitting it.

A different point of view is that it would be wrong to allow students to graduate with a degree in Computer Science if they do not have basic programming skills, experience in using a computer at first hand and may actually still be very unsure of their ability to function in a computer environment.

We at Unisa believe that steering a middle course is best. Practical programming is a necessary part of a Computer Science course but is not the overriding consideration and should not be over-emphasised.

7. THE FUTURE

Just as the technological advances of the past fifteen years have influenced the ways in which we have handled the teaching of aspects of Computer Science, so we expect that new developments will have a large impact on this area. Electronic mail, national networks and the advances made in Computer-Assisted Instruction are all being investigated to see how they can be used in the future. Prof. N. F. du Plooy and his co-authors deal with a number of advances in Information Technology in the paper he is presenting at this conference (The application of Information Technology in distance teaching).

Some research has been started at various universities overseas into the use of advanced technology in distance teaching. For example, Fernuniversitat has started a project on the use of electronic media for distance teaching and remote learning [Schlageter, p. 24]. This project envisages linking students and staff by means of a sophisticated on-line communications system. Use will be made of "electronic course material" using graphic presentation as well as text, and the student will also be able to explore and experiment with course-related tools. The Open University of The Netherlands has also embarked on a research project investigating the use of home computers linked into a network [Mulder, p. 83]. Both these research projects favour the use of systems where the student works on his microcomputer independently most of the time, and only makes use of a communications network occasionally to transmit programs or data [Bork, p. 26; Schlageter, p. 25].

It was suggested by De Wet and Calitz at the World Conference on Computers in Education in 1981 that computers have a role to play in correspondence education in Africa [De Wet, p. 566]. Mrs Fallick has also listed a number of advantages that could be gained by spearheading such a project in the Computer Science department of a distance teaching university [Fallick, pp. 39 and 46].

Research into aspects of Computer-Assisted Instruction in teaching Computer Science, in particular, is under way in our department. Mrs. Fallick has developed a COBOL preprocessor as a teaching tool which assists students in learning COBOL by identifying syntax errors as each line of code is entered.

8. CONCLUSION

In the 16 years in which Computer Science has been offered as a subject at the University of South Africa, we feel we have learnt a great deal about what should be taught and how this can best be done. Frequently this has been learnt by trial and error. However, we have a policy of periodically revising our courses to adapt to changing requirements so that courses do not simply evolve, nor are they subject to endless ad hoc adjustments, but are planned to meet the challenges of the times.

Frequently these changes are in response to the advances made in Information Technology. The Computer Science student studying at Unisa in 1987 should find his practical work more rewarding and will certainly have more practical experience in using a computer than the typical student registered for this subject ten or fifteen years ago. We feel confident that the new generation of graduates emerging from this department will not only have an understanding of the theory of Computer Science but will also be reasonably competent in their handling of a computer in practice.

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DIE GEBRUIK VAN INLIGTINGSTEGNOLOGIE IN AFSTANDSONDERRIG

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1. INLEIDING

Met "inligtingstegnologie" (IT) word bedoel die aanwending van gesofistikeerde tegnologiese hulpmiddele vir die versameling, verwerking, opberging en verspreiding van inligting. Hierdie tegnologie word tans gekenmerk deur:

(a) die skynbaar onstuitbare groei in vermoë en kapasiteit, gepaard met 'n beduidende afname in koste en fisiese grootte van veral elektroniese apparate.

(b) die integrering van tegnologië wat voorheen as aparte tegnologië beskou is, naamlik rekenaars, telefoon en telekommunikasie en kantoortoerusting, en

(c) die vermoë om stem, beeld en grafiese vorme te integreer, te berg en te manipuleer.

Soos u maar te goed weet, het ons by Unisa te doen met 'n baie groot studentepopulasie met uiteenlopende ouderdomme, opvoedingspeile en kulturele agtergrond. Ons kommunikasiemedium is primêr die geskrewe woord. Ons wil beweer dat die klassieke afstandsonderrigmodel van Unisa vanweë hierdie redes onder baie groot druk verkeer. Platweg gestel, ons "verdrink" in papier, en lewer waarskynlik nie meer in alle opsigte 'n uitnemende diens aan ons studente nie.

Ons dink dat dit dringend noodsaaklik is dat Unisa 'n afstandsonderrigmodel moet formuleer wat pas by die eise van die toekoms, en wat gebruik maak van alle moontlike media om die massiewe kommunikasieprobleem waarvoor ons oor jare te staan gekom het, die hoof te kan bied.

In hierdie referaat wil ons poog om die plek van IT in so 'n "nuwe" model te skets. Ons doen dit met die wete dat IT nie die panasee is of die enigste oplossing nie. Ook weet ons dat ons met hierdie referaat dalk meer vrae as antwoorde sal ontlok. Ons weet egter dat ons nie veel langer met die huidige model, wat ontwikkel is oor die jare en wat eintlik gebaseer is op 'n baie kleiner Unisa, sal kan oorleef nie.

2. HOE IT AANGEWEND KAN WORD

In die sake- en bedryfswêreld word soortgelyke kommunikasieprobleme as wat ons by Unisa ondervind, tans aangespreek deur wat breedweg bekend staan as kantooroutomatisasie. Onder hierdie term word verstaan die aanwending van rekenaars en verwante elektroniese toerusting wat verbind word in 'n netwerk om sodoende te poog om interpersoonlike kommunikasie (spraak, dokumente, ensovoorts) binne kantoorverband (en na buite) te verbeter.

By Unisa het ons, met die ingebruikneming van die huidige studente-administrasiestelsel, die nuwe stelsel by Redaksie, en meer onlangs, die oorskakeling na woordverwerkers, reeds die eerste stappe in die rigting van kantooroutomatisasie geneem.

In hierdie afdeling wil ons nou graag probeer aantoon hoe verdere uitbreiding van die kantooroutomatisasiebegrip, die werk van veral die Unisa-dosent kan vergemaklik.

2.1 Studiemateriaalverspreiding

Inligtingstegnologie open hier vir Unisa nuwe moontlikhede, veral ten opsigte van kommunikasie op ander media as papier.

By die Electronic University in die VSA [Osgood, 1986] word die studiemateriaalpakket aan 'n student saamgestel uit geskrewe materiaal en rekenaardiskette waarop veral werkopdragte geplaas word. Die rekenaar

vervul hier die rol van 'n dosent wat die opdragte aan die student gee en hom deur die studiemateriaal begelei. Die Electronic University gebruik hier dus tipiese rekenaargesteunde onderrigmetodes, wat reeds aan die meeste van u welbekend is. So 'n proses kan verder verpersoonlik word deur klankkasette of video wat verdere verduidelikings of instruksies gee.

Verspreiding van materiaal hoef ook nie deur die pos en op papier te gaan nie. In Oostenryk word Plato-agtige (dit is rekenaargesteunde) lesmateriaal via hul Videoteks-stelsel (iets soos ons Beltel) versend [Huber, 1986]. Die lesse word dan op 'n disket in die student se rekenaar afgeneem. In Hongarye word rekenaarsagteware tydens rekenaaronderrigprogramme op hul plaaslike TV-diens na kykers versend, bloot deur gebruik te maak van die oudioband van die TV-kanaal. Geen spesiale toerusting, benewens 'n bandopnemer wat aan die TV-stel gekoppel word, is daarvoor nodig nie [Temesi et al, 1986].

'n Geruime tyd nou al wend die SAUK 'n sender wat saans onbenut is, aan om die oorspronklike klankbaan van 'n vertaalde TV-program te versend. Ons insiens is dit ook 'n moontlikheid wat deur Unisa benut kan word vir kommunikasie met sy studente.

Die moontlikheid van Beltel word elders bespreek, daarom wil ons dit nie hier in besonderhede aanroer nie, behalwe om te benadruk dat die moontlikhede van hierdie stelsel deur Unisa uitgebuit en selfs aangepas behoort te word.

In 'n onlangse boek [Gooler, 1986] beskryf Dennis Gooler 'n ambisieuse plan om skoolonderrig te moderniseer deur onder andere van rekenaars, satelliete, netwerke en reuse-inligtingsdatabasisse gebruik te maak. Alhoewel dit na 'n toekomsdroom klink, moet ons daarvan kennis dra dat die voorstanders van hierdie sogenaamde "Education Utility" reeds die samewerking van die grootste telekommunikasiemaatskappy in die VSA verkry het, en aktief werk aan die realisering daarvan.

Dit word tyd dat ons weer met nuwe oë na Suid-Afrika se telekommunikasiemoontlikhede kyk. Onlangs het ons gehoor dat ons telefoonstelsel winste toon, soveel so dat die posdiens daardeur gesubsidieer kan word. Dit lyk dus logies om meer van eersgenoemde as laasgenoemde gebruik te maak vir kommunikasie met ons studente. Unisa moet ook nie net na die Poskantoor se netwerke kyk nie - dit mag wees dat ander bestaande landwye netwerke van privaat ondernemings of van die vervoerwese tot ons beskikking gestel kan word.

Laastens net 'n opmerking oor koste. Sodra daar gepraat word oor rekenaars of videomasjiene tuis by studente, word die koste-aspek onmiddellik as 'n onoorbrugbare probleem gesien. Ons moet egter onthou dat Unisa nie klein is nie. Wanneer vervaardigers hoor van getalle soos 95 000 moontlike kliënte, plus 'n verdere 20 000 per jaar, kan kostes dramaties daal. Verder moet ons ons dalk nie blind staar teen studente wat net vir 'n enkele graad by Unisa inskryf nie. Moet ons nie dalk ons aandag vestig op wat Silvia Sharp van die VSA [Sharp, 1986] "life-long learning" noem nie? Lê Unisa se missie nie dalk baie breër as graadopleiding nie? Moet voortgesette onderrig nie dalk ook op die afstandsonderrigmodel funksioneer nie? Vir 'n "life-long" student is die aankoop van 'n rekenaar waarskynlik nie so 'n groot uitgawe nie.

2.2 Studente-evaluering

Direkte verbinding van elke dosent, of dan ten minste van elke doserende departement, aan die studente-databasis beteken dalk dat dosente self die resultate van die evaluering van werkopdragte en eksamens, in die rekenaar kan invoer. [Dit kan selfs met behulp van 'n ligpen gedoen word as u dalk bang is dat u verkeerd sal tik!]. So 'n werksmetode voldoen aan 'n belangrike dataverwerkingsbeginsel, naamlik van eenmalige vaslegging van data by die oorsprong daarvan.

Telekommunikasienetwerke soos voorheen bespreek, kan benewens verspreiding van studiemateriaal, ook aangewend word deur die student vir kommunikasie met die dosent, asook vir die beantwoording van werkopdragte, selfs dalk vir eksaminering oor 'n afstand.

Diegene wat die multikeusevraagmetode nuttig en doeltreffend vind, kan die hele proses outomatiseer deur die student die antwoord op die vrae via 'n gewysigde tipe telefoon of 'n rekenaar of Beltel na Unisa te laat versend, en hy kan dan dadelik van sy resultate in kennis gestel word! Ongetwyfeld 'n veel beter aansporing aan die student, en 'n verdwyning van 'n lastige afsnydatum vir die dosent!

2.3 Voorsiening van boeke en artikels deur die biblioteek

Die biblioteek eksperimenteer reeds met die gebruik van Beltel vir bestellings. 'n Verdere aanwending van IT is moontlik om vanaf terminale by streekskantore of by studente se huise toegang tot die katalogus van die biblioteek te verkry. Dit sal veral vir afgeleë nagraadse studente 'n verbetering in ons diens wees.

Verder kan mens ook gerus die moontlikheid ondersoek om fotokopië van artikels deur middel van faksimileetransmissie na die student te versend.

2.4 Rekenaargesteunde onderrig

Nuwe ontwikkelings op hierdie gebied is besig om die ou belangstelling en opwinding (wat nie juis wou realiseer nie) weer gaande te maak. Ons wys veral op die gebruik van interaktiewe video, saam met rekenaar en klank. Hierdie medium is veel meer lewendig en lewensgetrou. Aangesien daar genoeg oor gepraat is elders, gaan ons nie hier verder daarop in nie.

2.5 Studente-administrasie

Tot dusver het die dosente by Unisa nog nie toegang tot al die voordele van ons eie studente-administrasiestelsel nie. Met 'n eie plaaslike netwerk, en 'n rekenaar of terminaal op die lessenaar van elke dosent, of ten minste van elke departementele sekretaresse, is dit in beginsel

moontlik om die akademiese rekord en huidige vordering van elke student, met relatiewe gemak na te slaan. Ons kan dan, net soos ons kollegas in die Administrasie, toegang hê tot die jongste werkopdraginligting en so meer.

'n Tweede saak wat ons onder hierdie hoof wil bespreek is dié van studente-advies. Dit is in beginsel moontlik om oor 'n afstand advies in verband met kursuskombinasies, graadmoontlikhede en so meer, aan studente te verskaf. Dit kan bereik word deur, by Unisa, die kundigheid van 'n studente-adviseur vas te vang in 'n sogenaamde "kennisbasis". Deur middel van geleide vrae kan 'n student dan, miskien via Beltel, hierdie basis raadpleeg. Soortgelyke tegnieke word tans op ander gebiede gebruik om 'n sogenaamde "kundige stelsel" (Engels: "expert system") daar te stel. Tipiese voorbeelde vind ons reeds by mediese diagnose. Ons departement onderneem tans navorsing hieroor met die oog op die gebruik van kundige stelsels in studente-advies, asook in onderrig.

2.6 Studiemateriaalvoorbereiding

Die "geskrewe" woord sal seker altyd primêr staan binne 'n afstandsonderrigmodel, of die draer daarvan nou papier of 'n ander medium is. Dit is dus voor die hand liggend dat Unisa-dosente alle moontlike hulp moet kry om hierdie belangrike gedeelte van hul werk so doeltreffend moontlik te kan doen.

Ons is reeds besig om meer en meer woordverwerkers by Unisa in te voer. As 'n dosent self op 'n woordverwerker kan werk, gebeur daar twee belangrike dinge:

(i) omdat die "vaslegging" van die inligting (die studiemateriaal) by die bron (die dosent) plaasvind, word foute as gevolg van oortik en tydsverspilling ten opsigte van proeflees, dramaties verminder.

(ii) die kwaliteit van die skryfkuns van die dosent verbeter as gevolg van die vermoë om teks dadelik te wysig, paragrawe rond te skuif en so meer.

Hierdie tegnologie maak dit moontlik om die finale kopie van die gids of studiebrief in die dosentekantoor te produseer (met of sonder 'n draai by Redaksie vir taalversorging).

In die praktyk is so 'n stelsel moontlik want u moet in gedagte hou dat alle studiemateriaal elektronies herwinbaar is, elektronies gerangskik kan word, en finaal gedruk kan word deur byvoorbeeld 'n hoëkwaliteit laserdrukker waarop produksievolume nie juis 'n beduidende invloed het nie.

Let daarop dat, met hierdie benadering, die dosent ook sketse, kaarte en diagramme op die woordverwerker as 'n integrale deel van sy manuskrip, kan produseer. Met toekomstegnologie kan 'n studiepakket saamgestel word wat bestaan uit geskrewe handleidings, klankkasette en rekenaargesteunde onderrig en evalueringsaspekte, alles by een enkele sogenaamde werkstasie.

Hierdie benadering het een baie opwindende moontlikheid, en dit is naamlik die herbeplanning en moontlike individualisering van studiemateriaal. As ons kan wegbeweeg van die huidige rigiede produksiestelsel, kan

(i) studiegidse en studiebriewe jaarliks opnuut opgestel en bes moontlik ook saamgevoeg word.

(ii) dosente veel meer vryheid gegee word ten opsigte van die formaat van hul studiemateriaal.

(iii) 'n dosent vir 'n bepaalde student 'n unieke studiepakket saamstel.

Ons beweer dat 'n dosent veel meer produktief kan wees as hy met so 'n buigsame publikasiestelsel vir die finale produk wat na die dosent gaan, verantwoordelik is.

IMPLIKASIES VAN DIE GEBRUIK VAN IT BY UNISA

Ons het in die begin dit duidelik gestel dat IT nie die panasee is vir al Unisa se probleme nie. Ons is egter oortuig dat 'n nuwe afstandsonderrigmodel wel deeglik van die moontlikhede van IT moet kennis neem.

Om mee af te sluit, wil ons graag op enkele implikasies van die gebruik van IT wys.

Die voorstanders van kantooroutomatisasie skryf reeds oor "papierlose" kantore. Laasgenoemde beteken dat die personeel van so 'n kantoor nie meer nodig het om die kantoor self te besoek nie, maar gewoon van hul huise af hul werk verrig.

Is so iets by Unisa moontlik, of selfs wenslik? Ons kan eerstens die moontlikheid beskou. Met voldoende netwerke, moontlikhede van dokumentasieoordrag van huis na Unisa, goeie telefoonverbindings wat konferensietelefoonfasiliteite insluit, 'n gerekenariseerde biblioteek en so meer, is so 'n model inderdaad moontlik. In beginsel kan ons die oorgrote meerderheid van ons werk, navorsing en studentekontak ingeslote, van ons huise verrig. Dit beteken dat Unisa 'n "verspreide" universiteit kan word!

Volgens ons pas so 'n model baie goed by die afstandsonderriggedagte in. Ons hoor dikwels van die gebruik van "tutors" of "supervisors" in ander sentra. Waarom nie ook die dosente versprei nie?

Die wenslikheid van so 'n gedagte verg heelwat meer studie en besinning, waarvoor die tyd nou te beperk is. Let egter daarop dat die gedagte van 'n "verspreide" dosentekorps slegs oorweeg kan word as die kommunikasie tussen dosente effektief bewerkstellig kan word.

'n Tweede implikasie van IT se gebruik is dat een belangrike beswaar teen afstandsonderrig dalk aangespreek en selfs opgelos kan word. Die gedrukte woord kan naamlik geredelik die plek inneem van 'n lesing volgens die bywoningsmodel, maar minder geredelik dié van die voorbeeld van die dosent nie. 'n Student leer gewoonlik net soveel of meer, deur te sien hoe 'n dosent 'n probleem oplos, of hom te hoor redeneer. Unisa probeer laasgenoemde aanspreek deur groepbesoeke op streeksbasis te reël en klankkasette te versprei. Ons kan ons tereg afvra of eersgenoemde nie dalk 'n teruggrype na die bywoningsmodel is nie. Volgens ons mening vereis die afstandsonderrigmodel dat direkte studentekontak op dié wyse tot 'n minimum beperk moet word, want dit is nie werklik onderrig op 'n afstand nie. Met rekenaarbegeleiding, en veral met rekenaargekoppelde video en klank, kan ons dalk hierdie tekortkoming van ons model korrigeer op 'n wyse wat wel binne ons model tuishoort.

'n Rekenaar in die student se huis, of by 'n streeksfasiliteit, kan hierdie probleem tot 'n groot mate oplos. Deur beeld en klank geïntegreerd met rekenaargesteunde onderrig te gebruik, kan die onderrig verpersoonlik word, en kan 'n voorbeeld wel aan die student oorgedra word. Let ook daarop dat rekenaargesteunde onderrig 'n aktiewe vorm van onderrig is, en nie passief soos wanneer slegs van klank of beeld gebruik gemaak word nie.

'n Verdere implikasie is dat ons van mening is dat die tyd vir oormatige sentralisasie van aktiwiteite binne Unisa, verby is. IT word goedkoper en steeds beter, sodat elke dosent se kantoor byvoorbeeld 'n studiemateriaalproduksiepunt kan word, soos vroeër aangedui. Sentralisasie van dosente is ook nie meer noodwendig 'n vereiste nie.

So 'n beweging na 'n gedesentraliseerde Unisa, is volgens ons 'n positiewe een. Dit beteken dat die begrip "akademiese vryheid" nuwe betekenis kan kry as die rigiditeit van 'n gesentraliseerde stelsel afgewerp kan word. Natuurlik bemoeilik dit beheer, en waarskynlik 'n hele aantal ander sake, maar om daaraan reg te laat geskied, skep weer nuwe uitdagings.

'n Laaste implikasie is dat ons met nuwe oë na die bestaande onderrigmodel, en die bestaande tegnologiese steun daarvoor, sal moet kyk. Ons kan nie meer bekostig dat rekenaarstelsels vervaardig word slegs vir die administrasie of slegs vir Redaksie of slegs vir die dosente nie.

Daarom beweer ons dat dit dringend noodsaaklik geword het om aktief navorsing te doen oor die aanwending van IT by Unisa, sodat ons daardeur, en met inagneming van wat elders by hierdie konferensie gesê is, tot 'n nuwe eiesoortige afstandsonderrigmodel van Unisa kan kom.

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COMPUTER-AIDED EDUCATION AS STUDENT CENTRED EDUCATION: PRACTICAL APPLICATIONS FOR TODAY AND IN THE FUTURE

- Dr P J van Dyk

SUMMARY

The intention of this paper is to show that the computer can solve many of the current problems in distance education and that many of the advantages of distance education can further be enhanced by the micro or mainframe computer. A practical and existing program which enables students to do their assignments directly on a micro computer is explained. This program was designed in such a way that it expects minimal if any previous knowledge of computers by both the lecturer and the student. Practical suggestions about implementation and future possibilities are made.

INTRODUCTION

My experience at seminars and in discussions with my colleges has given me the impression that most people think that computer (aided) education is still a long way in the future. Personally, I do not think that this is the case, because the relevant programs and computer equipment already exist, at least to start experiments with computer instruction. The intention of this paper is to show that the computer is able to solve many of the current problems in distance education and that many of the advantages of distance education can be further enhanced by the micro or mainframe computer.

I am not an educationist and it is not my intention to wander into the theoretical field of the science of education. In this presentation I shall rely on my personal and practical experience in distance education as well as with the computer.

A. THE PROBLEMS OF DISTANCE EDUCATION

Distance education has unique problems, and problems which may not be unique. Problems for the student but also problems for the tutor. The following can be listed as some of the more pressing problems in the current situation:

1. Problems for the student:

a. A lack of immediate response to his problems: Even though students can write letters or telephone their lecturers, experience and a study in our department by professor Deist has shown that this is not as easy as it sounds. Only a very small percentage of students make any contact with lecturers. Most of the time it is the same few students who repeatedly telephone the university. Most students refrain from making contact because they are afraid to confront a very learned professor or lecturer with what they think may be a stupid question. Students also complain that it is extremely difficult to get hold of lecturers. The time when students are free to study (for example: in the evenings and early mornings) is exactly the time when lecturers are not readily available.

Another major problem, connected with the previous one, is the very long time-span between the completion of an assignment and the receiving of the results and comments on the assignment: the enthusiastic student who completes his assignment three weeks before the due date will wait at least another three or more weeks for it to be marked, and, if he lives far away in the country, it may take another two weeks to reach him through the post. It is not unusual for a student at UNISA to wait two months for the results and/or comments on his assignment. This is undesirable, but in very large departments it is sometimes inevitable.

b. A lack of individual response to an assignment:

In very large departments (like Old Testament which deals with more than 6 000 students) it is almost impossible to give students detailed comments on their assignments. Even though lecturers try their best the number of students is so overwhelming that individual comments on an assignment become almost impossible (especially in the present situation with increasing student numbers and very few additional teaching staff appointments). This is frustrating to the student and the fact that he is 'only a number' reduces his motivation.

c. Problems with deadlines for assignments:

One of the biggest problems for the working student is that his work programme is not always within his own control. This usually results in a situation were he misses some of the due dates for assignments. This problem is aggravated by the fact that lecturers are very reluctant to grant an extension to an assignment. Even with multiple choice assignments an extension is not always possible because this delays the marking process. This problem is unfortunate, because it reduces the benefits of distance education.

d. Too few assignments:

Though this may be a problem for the better student only, it is still one of the problems of distance education. In the larger departments it is almost impossible to mark more than a certain number of assignments. Even multiple choice assignments have their problems, as indicated below.

2. Problems for the lecturers:

a. Very boring work

I think that this issue should really be brought into the open. I am sure that the heads of departments and the senior management of the university are concerned with the job satisfaction of their staff. It is imperative that lecturers should not be expected to mark 400 to 600 assignments within three weeks. Some may argue that it is only at certain stages of the academic year that this type of workload is encountered, and that it should therefore be tolerated. This is not a convincing argument because it remains a very important factor in reducing a lecturer's enjoyment and satisfaction in his work.

Multiple choice assignments may be a solution but in a batch of 3 000 first-year students' punch cards one may find up to 500 incorrectly punched. These cards (even if they are not marked by hand) have to be

taken out by hand and sent back to the students by hand, and all the student numbers, names, credit marks and marks need to be written down. This is indeed a very boring and time-consuming job. Another problem is that the computer sometimes skips a card during the marking process. This can cause a lecturer to have to look through all 3 000 punch cards to try to retrieve the missing cards. These are real problems and make aspects of the job experience of the UNISA lecturer very boring and frustrating.

b. The unequal spread of work:

The workload at UNISA differs greatly during different times of the year. Just before an assignment is due and for at least a month and a half after the due date the workload of a lecturer sometimes becomes unbearable. All his administrative and research tasks then come to an abrupt halt, while he tries his best to cope with letters and telephone calls, and students coming to see him with problems. Not only is this frustrating but it also reduces the quality of teaching and instruction given to students.

B. THE ADVANTAGES OF DISTANCE EDUCATION

In the past the emphasis was placed on the separation of tutor and student as the main characteristic of distance education and this was seen as both a disadvantage (in the sense that contact between lecturer and student is limited) and an advantage (in the sense that the student do can continue with his career and do not need to stay in one specific city/town). But these are not the only advantages of teletuition. There are other benefits.

* Within the limits of the academic year the student can set his own work tempo.
* He can decide what time of the day, week or year he wants to dedicate to his studies.
* The student can take a longer time to complete his degree.
* The student receives all his notes complete and neatly structured.

* The student can start or continue his career while he is busy studying.

If this is true the name 'distance' education or 'teletuition' may be a little one-sided. 'Student centred' education may be a more positive and a less one-sided name. That the student can stay were he wishes, study when he wishes and at his own speed, and continue with a career, must be indeed the ultimate in student centred education. These advantages make distance education increasingly attractive to thousands of students. With computer-aided instruction some of these advantages can even be increased.

C. COMPUTER AIDED EDUCATION FOR TODAY

The problems we have mentioned can, to a large extent be eliminated and the advantages of distance education further enhanced by computer education.

1. Characteristics of an existing program

At the present moment, it could become possible for the student (living in the bigger centres) to complete his/her assignments directly on a micro computer. This is not wishful thinking. In our department I wrote a program based on DBaseIII for the Biblical Studies II students that contains 35 assignments. Both the program and the assignments fit onto a single floppy disk. The advantage of my program is that it needs no more computer literacy than using an autobank does. Neither lecturers nor students need have any previous knowledge of a computer.

a. Creating new assignments: The lecturer or secretary needs only to choose the relevant course, and the language of the assignment: he gives it an assignment number and then types in the questions, the correct answers and the reasons for a specific choice. The program is menu-driven and creates its own new program that can immediately replace a previous assignment. A rotation system of at least five different assignments for each section of the work is done by the computer in such

a way that it will be difficult for a student to know beforehand which assignment to expect. Although it is not foolproof, this will help to prevent a student from just copying the correct answers from a friend's assignment. The results of all the students who have done assignments can be printed out by the secretary on the following day and sent through to the assignment department.

b. Completing an assignment

The student makes a choice of language, course and the desired sub-section of the course. This is done by typing in the relevant number. The computer then selects one of five possible assignments and gives the first question. In the case of a multiple choice question the student must then choose the correct number. After he has made his choice he is immediately told if the answer is correct or incorrect and the reasons for the correct answer are commented on. In this way one question after another is displayed on the screen and the student only needs to type in the correct number.

When he has finished the assignment his results are displayed on the the monitor and he can choose if he wants the assignment to count for examination purposes or not. If he wishes it to count for credit marks he is then asked to fill in his student number, initials and surname. This is the only typing required of him. The student receives a printout of the whole assignment which can further help him in his preparations.

2. The advantages of such a program

a. To the student

* Immediate results and commentary on assignments. In the case of multiple choice questions he can then immediately see where his mistakes lie and correct them.
* No due dates. This enables the student to work at his own speed and even in the case of illness or any other major mishap he can still

do the necessary assignments for examination preparation and obtain enough credits to sit for the examinations.

* The fact that a student can choose if a assignment should count or not. This enables him to obtain a certain desired standard.
* Better and more preparation for the examination because of the larger number of assignments. Not only can he complete more assignments, but all of them are marked.
* No personal rejection need be felt by the student when he fails an assignment, because not even the lecturer needs to know. In this way no discrimination on grounds of a previous bad assignment is possible.

b. To the lecturer

* A more even spreading of his workload. Because he need not worry about marking assignments within three weeks, he can continue with his other work. Because students work at their own rate a more even distribution of enquiries about problems will also be probable.
* It may be possible to give better instruction to students and more thorough preparation for the examinations. Crash courses for students or over hasty explanations should not be necessary.
* All the problems with preparing and dealing with punch cards will increasingly be eliminated and even though the setting of many more assignments will, at the beginning, create more work it will in succeeding years prove beneficial.
* Any problems with some of the assignment questions, typing errors and so on can also be corrected immediately and this can save the lecturer hours of explaining over the telephone.
* We think that better job satisfaction and happier lecturers will be the result.
* The compilation of a large number of questions and assignments, will compel the lecturer to come to grips with the detail of prescribed books. If he wrote the book himself it is possible to deduce from the students' results whether all sections of the work is intelligible or not. In this way guidance can be better and problem areas can easily be identified.

* Productivity can be increased because lecturers will be forced to pay more attention to the compilation of high quality assignments in stead of doing boring jobs like sorting punch cards.
* The intelligence and creativity of lecturers may be stimulated by the challenge of compiling and innovating new type of questions and improving the programs for the computer.

C. PROPOSED WAYS OF IMPLEMENTATION

The biggest problem with the implementation of computer aided education is an economic one. Everybody realises that computer hardware and software are very expensive. This however need not to be the reason why this highly beneficial type of education should be pushed into the distant future.

1. First phase

As a start, one can supplement written assignments by making the micro computer/s in the department available to students, for example in the afternoon when most secretaries do not use their computers. Later this service can be extended to the library, study centres and regional offices. The fact that a very large percentage of UNISA students live close to such centres and the fact that all the students still have the choice to do the existing assignments and send them in by post make this a feasible scheme. The fact that in the beginning not all students will have access to the system should, in my opinion, not be used as an argument against using the computer. This is also true of group discussions and many other benefits offered to students (for example many of the library facilities). The benefits of computer assignments will probably motivate many students to go to an available computer to complete their assignments. The emphasis will lie more on examination preparation than on obtaining admission to sit for the examinations.

This first phase of implementation could start immediately with currently available hard and software. With better planning and utilisation of the computer equipment the university is ready to make a start now.

With few additional costs the program can later then be extended to other centres.

2. The second phase

The ultimate goal is to have a mainframe computer joined to many keyboards and monitors throughout the country. On such a system the results could immediately be processed by the university's computers so that it would not be necessary to type the results into another computer. The service could then be extended to smaller towns where the private sector and people who were willing could make their micro computers or other equipment available to students at certain hours and at a certain fee, payable by the university. These stations could then be linked to the central computer via the telephone line. Students who had their own computers could phone directly into the main computer (at any time) and complete their assignments from within their own homes.

In this phase a more relaxed registration and examination system could also be introduced. Certain courses could be examined throughout the year, by the computer. For example, in the bigger centres a constant examination centre could be opened (in the library?), attended by personnel. I visualise small one-man cubicles with monitors inside linked to the computer. The personnel would need to control only the student's entrance into the cubicle to make sure that he had no illegal notes or study material with him. Then the cubicle could be locked from the outside and no further attendance would be needed. This would not necessarily be a very expensive or labour-intensive system. In this way the student could write his examinations when it suited him best. (Different papers should of course then be compiled but in any case this is done from year to year.) The student would receive his results immediately and if he failed the examination he could attempt it again within a few weeks or months without it being necessary to repeat the whole course.

If this type of examination could be introduced (I do not see why not) a more flexible registration system could also be developed. A student

could for that matter register for one course at a time. The moment he had successfully completed the first course he could register for a second course.

All these final suggestions are for the future, but they are more than possibilities. I believe that the university should consider them and plan for the future. In this way distance education will truly become student centred education.

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